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August 2015
Issue 418

YOUR EXPERT

GUIDE TO TODAY'S TECH

**4K-GAMING
GPUs COMPARED**

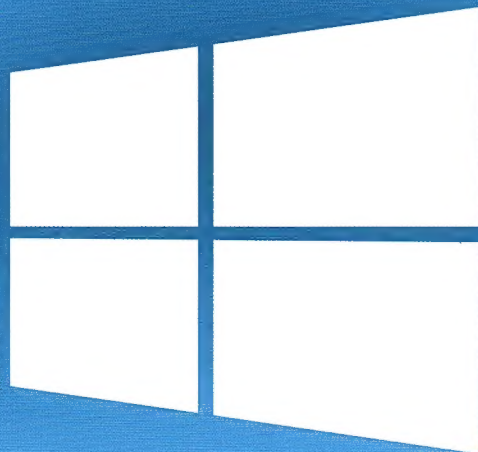
Nvidia & AMD go
head-to-head for
megapixel framerates!

HOW TO GET IT FOR FREE

Got Windows 7 or 8?
You can upgrade
right now for nix!

HOT NEW FEATURES

Get to grips with
the all-new Start
menu & speedy
Edge browser!



WINDOWS 10 IS HERE!

MICROSOFT'S BOLD NEW OS FOR PCs, TABLETS &
SMARTPHONES HAS FINALLY ARRIVED... SO IS IT ANY GOOD?

YOUR QUESTIONS ANSWERED: WHAT'S NEW, WHAT
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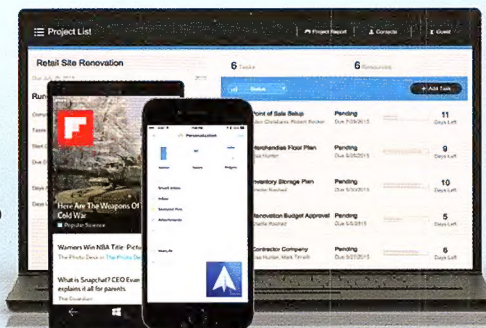
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- Create a 3D game with Unity
- Make your own Chromebook laptop
- Build a Pi-powered weather station

LATEST TECH LABS-TESTED

- ASUS's G-Sync gaming laptop
- AMD's R9 390X: a GTX 980 beater?
- Dell's affordable 11in Chromebook



INTRIGUING NEW APPS!

New software
for Windows,
Mac, Linux,
Android and iOS
expert tested!





VENOM

BLACKBOOK

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APC is published by Future Publishing Australia.

Distributed in Australia and NZ by Network Services.

Printed by Webstar

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Is Windows 10 Microsoft's much- needed win?

APC's editor ruminates on the launch of the
latest version of Windows — and what it
means for Microsoft and the rest of us.

Over its comparatively short
development period, I've
heard some people
uncharitably calling
Microsoft's new OS 'Windows 7.5',
for the perceived 'step backwards'
that the company has had to take
with regards to the Start menu.
Indeed, Windows 10's most welcome
change is probably going to be the
removal of a feature, rather than
the addition of a new one: Windows
8's clumsy Start screen is dead!
Long live the Start menu!

But that's not all that's new in
Windows 10 — this is far more than
just a quick rework of Windows 8.
Microsoft's made further
improvements under the hood to
support a wider array of hardware,
meaning that this is going to be the
company's most flexible OS yet, able
to run on smartphones, tablets, PCs
and even the 'single-board PC'
Raspberry Pi 2.

And in terms of what it's reworking,
Microsoft seems to be making all the
right moves. The long reviled (at least
by the tech savvy) Internet Explorer
is being replaced with a newer, faster
browser called Edge. There's a built-in
personal assistant called Cortana
that, much like Apple's Siri on iOS,
will respond to simple voice requests
and commands.

Even PC gaming may get a kick-on
effect from the launch of Windows
10, with the OS's new DirectX 12
offering to lower system overheads
and potentially improve frame rates
— by varying amounts, depending on

who you listen to. (That's something
we plan to look at in a later issue once
the OS, and the graphics drivers for it,
are both final.)

After spending several months
with the new OS, we're quietly
hopeful. And for those doubters, it's
worth noting that Microsoft has
pulled off swift turn-arounds before.
It managed to turn the disaster that
was Windows Vista into the triumph
of Windows 7 in around 2.5 years.
(For the record, it's taken a similar
amount of time for the company to
complete Windows 10 after releasing
Windows 8.)

While we've reviewed Windows 10
this month based on the near-final
builds that were released in early
July, ultimately whether the OS is a
success will depend on you, the PC
enthusiasts and professionals, and
whether you think it's worth
upgrading to. (And of course, what
you tell all those people who rely on
you for tech support.)

Microsoft undeniably struggled
over the last decade, but it's a much
different company under Satya
Nadella. Windows 10 could be the
turning point it badly needs. ■

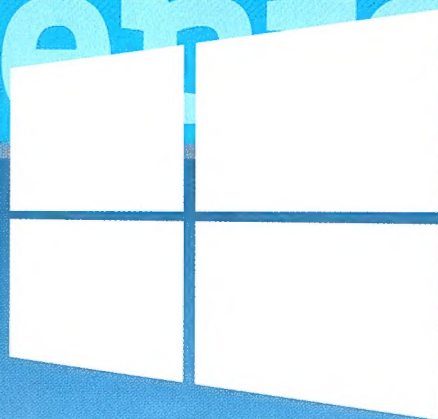


DAN GARDINER

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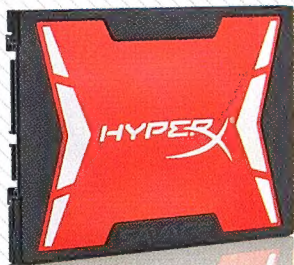
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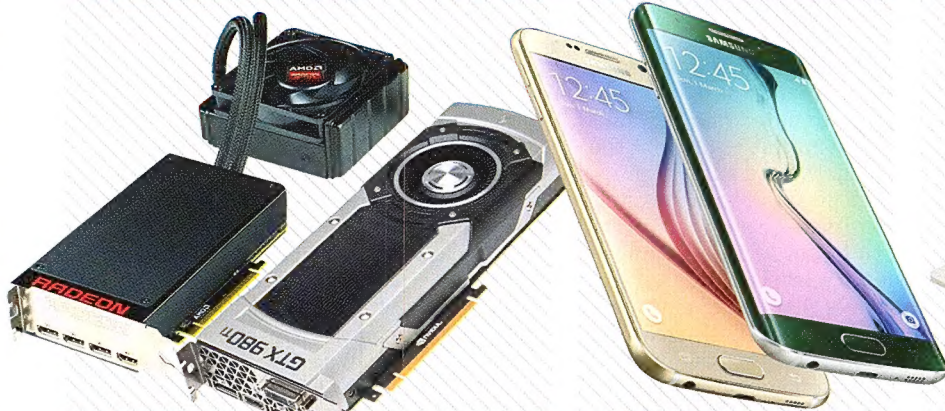
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Find your disc inside on page 83.



technotes

» NEED TO KNOW

More bad news for Dallas Buyers Club pirates

Draft letters suggest individuals liable for 'hundreds, if not thousands' of film copies.

Another twist in the ongoing Dallas Buyers Club piracy saga came in late June, as the Federal Court of Australia met to look-over the draft letters that will be sent to broadband account holders who are suspected of illegally downloading the film. Despite the fact that in the preliminary discovery hearing in April, both iiNet and the judge stated that the remuneration potential of the rights holders could be as little as the cost of purchasing a film, Voltage Pictures seems to believe it's entitled to a lot more.

The letter makes it clear that the movie company will be pursuing the cost of the individual infringement as well as the cost of all legal proceedings and any additional damages. Those 'additional damages' aren't articulated in the letter and this ambiguity is

what's perhaps most concerning.

The only reason Voltage Pictures hasn't already sent these letters to 4,726 Australian's mailboxes is because the judge mandated that the courts approve them first, to prevent the rights holders from extorting suspected pirates. Much to Voltage Pictures dismay, a suggested telephone transcript – for settling disputes outside of court – was also submitted and it's here that those 'additional damages' become a little clearer.

Apart from reinforcing that an immediate settlement "will not be the same amount claimed by our client should this matter proceed to court", the company also directs negotiators to explain that the damages pursued exceed the retail cost of purchasing the film because "our clients are also out of pocket for legal and compliance

costs [that] form part of the damage... to which they are also entitled to claim from you". The transcript further suggests negotiators explain that "any file shared [through a BitTorrent application] is made available to hundreds, if not thousands of persons, thereby giving a potential claim for multiple copies of our clients work".

These direct phone conversations are unfortunately not something that can be monitored by the courts. And though the documents don't explicitly cross the boundaries into speculative invoicing, they do leave open the option for the company to step into the legal shadows of a phone conversation, and use threats of expensive court proceedings as leverage to extract the highest settlement possible – which is exactly what the courts were trying to prevent in the first place. **Joel Burgess**

Silk Road founder sentenced to life in prison

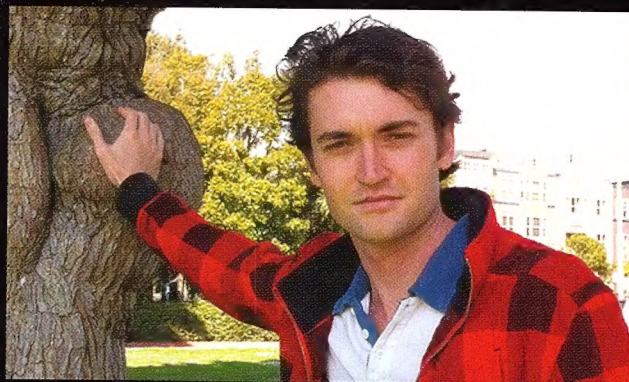
Bitcoins won't save you in the slammer.

Ross Ulbricht, better known as the man behind the infamous darknet drug marketplace Silk Road, has been sentenced to life in prison without the possibility of parole by a federal judge.

31-year-old Ulbricht, who ran under the pseudonym Dread Pirate Roberts, was convicted of seven felonies, including computer-hacking, narcotics-trafficking conspiracy, trafficking drugs on the internet, running a continuing criminal enterprise, money-laundering and the attempted murder of six people.

Ulbricht had originally pleaded for leniency in a letter to US Judge Katherine Forrest, which said "even now I understand what a terrible mistake I made." He went on to say, "I've had my youth, and I know you must take away my middle years, but please leave me my old age."

The judge also ordered Ulbricht to forfeit US\$184 million dollars. It's estimated that illegal drug transactions raked in



over US\$1.2 billion on Silk Road.

Ulbricht reportedly cried as the parents of his drug overdose victims spoke before his sentencing. **Stephen Lambrechts**

SourceForge adware angers open-source community

After drawing the ire of the open-source community for a couple of weeks, software directory SourceForge has published a blog post explaining how it will generate ad revenue going forward. The online repository landed itself in hot water after it was found to be bundling adware with free and open-source software downloads, most notably the Windows version of the GNU Image Manipulation Program (GIMP). In the post, SourceForge said the bundling was part of a test to see how palatable the ads would be. "SourceForge also recently ran a test of presenting easy-to-decline third-party offers with a small number (5) of projects mirrored on our site," the post continued. "This included gimp-win, but did not include nmap. We promptly discontinued this test based on community reaction."

The GIMP project took to its blog to chastise SourceForge, and indicated that the trust the community had placed in the web site had been irreparably damaged: "To us, this firmly places SourceForge among the dodgy crowd of download sites. SourceForge are abusing the trust that we and our users had put into their service in the past. We don't believe that this is a fixable situation," the post said.

"Even if they promise to adhere to the set of guidelines outlined below, these promises are likely to become worthless with any upcoming management change at SourceForge."

In response to the criticism and broken trust, SourceForge established a forum for its community members to share their ideas and suggestions. Unfortunately for SourceForge, that may not be enough. GIMP is already gone from SourceForge, and other open-source projects are leaving or feeling the pressure to leave, too.

A developer for Wine proposed migrating away, in a June blog post, due to: "SourceForge's recent activities with taking over open source projects for their own personal gain." You can also add elementary OS and Notepad++ to the list of open-source projects that SourceForge scared away with its adware actions.



Millions of Samsung phones still vulnerable to hacking

It's still not safe to use public Wi-Fi if you have a Galaxy phone.

In June, the Black Hat Mobile Security Conference in the UK was the bearer of bad news for Samsung, detailing a vulnerability occurring in over 600 million of the company's smartphones, including its latest flagship the Galaxy S6. It wasn't just a negligible, theoretical glitch either. The flaw could allow a hacker free reign on everything from the contents of text messages to relaying a feed from the device's inbuilt camera. Because the glitch stemmed from the integration of a third-party software keyboard created by SwiftKey, the popular swipe-typing app developer was unfairly adorned with at least partial responsibility. According to the researchers at Now Secure who uncovered the glitch (and who

claim to have told Samsung about it close to a year ago), Samsung is really the only one to blame. The Korean smartphone maker has stated that it intends to roll out patches using its Knox security subsystem, but at the time of writing there was no indication whether these updates had been successfully implemented or not. Joel Burgess



Use your Telstra broadband anywhere What do WiFi hotspots, broadband and old payphones have in common?

Telstra has switched on an unusual reinvention of the broadband plan. At the end of June, the company started offering a new broadband-come-Wi-Fi-hotspot network, dubbed Air. Using thousands of Telstra payphones retrofitted with Wi-Fi and a number of newly configured Wi-Fi hotspots, the opt-in broadband service basically allows Telstra's fixed-line broadband customers to use their monthly allocation of broadband data anywhere that the Air service is available. But while being able to access your broadband data on your phone or laptop anywhere sounds great in theory, there is a catch: you'll have to use one of Telstra's compatible 'Gateway' routers at home. These routers actually slice off a portion of your fixed-line internet bandwidth and make it available to other Air subscribers in the area. Considering how much flack the VPN service Hola Better Internet received for doing essentially the same thing, some Telstra customers are almost certain to find it a deal-breaker. JB

Is BlackBerry making an Android phone?

Former phone giant to focus on device management & software.

Despite copious amounts of praise for the 2013 launch of its BlackBerry 10 OS, the phone maker has struggled since the introduction of the smartphone, and its market share currently accounts for less than 1%. In June, Reuters reported that sources within the company claimed that BlackBerry was moving to focus on software and device management, and would embrace the Android platform, launching devices running the Google OS later this year. JB

Scientists develop game for weight loss And it doesn't need exercise...

In an attempt to help people cut down on impulse snacking, researchers from the University of Exeter in the UK have developed a simple game where participants are shown images of healthy and unhealthy foods and asked to push a button or refrain. The 10-minute a day sessions spanned a week in total, and apparently encouraged subjects to eat 220 fewer calories per day and lose, on average, a total of 0.7kg. JB



POTENTIAL RETURN ON INVESTMENT FOR CYBERCRIME.

Business security firm Trustwave has calculated the hard figures of cybercrime and shows that it does pay, and it pays well. Ransomware — whereby your computer's files are encrypted by an external source and then literally held to ransom under threat of deletion — is on the rise, and although a would-be attacker may spend \$5,900 a month on costs for hardware and encryption, they stand to make \$90,000. The figure was based on 20,000 visitors per day over a month-long campaign, a 10% infection rate and a 0.5% payout rate. Solution? Back up your computer, yesterday.

US\$9.1 million

AMOUNT THE U.S. NAVY IS PAYING MICROSOFT TO PROVIDE CUSTOM SUPPORT FOR XP.

Where can you find pleasure, search the world for treasure, learn science, technology — as long as the technology is 14 years old? In the U.S. Navy! The U.S. Department of Defense has contracted Microsoft to provide custom support for Windows XP, as the Navy still uses it alongside Office 2003, Exchange 2003 and Server 2003. The US\$9.1 million is just the award given for taking on the work. The contract will cost approximately US\$30,842,980 if support continued to a projected end date of 8 June, 2017, and if 'all options are exercised'. Yes, they want you, they want you, they want your computer to boot.



US\$500,000

THE PRICE OF WIKIPEDIA AS A HARDBACK BOOK.

It'll be 7,600 volumes large, will take two weeks alone to upload to on-demand printer Lulu.com and is, as described by artist Michal Mandiberg, a "half utilitarian data visualisation project, half absurdist poetic gesture". It's the English language version of Wikipedia as a book. However, Mandiberg doesn't intend to print out every volume: "We don't need to see the whole thing in order to understand how big it is," he says.



SIX figures

A PRO GAMER MAKES US\$100,000 A YEAR PLAYING LEAGUE OF LEGENDS.

They call the United States the 'land of opportunity', and for one 21-year-old Venezuelan named Diego "Quas" Ruiz, that's certainly proved true. Ruiz relocated to Los Angeles to pursue a career in professional gaming. He earns around US\$100,000 a year to represent Team Liquid in the multi-player online battle arena game *League of Legends*. Just like a traditional athlete, Ruiz practices roughly 10 hours a day in order to stay in top competitive gaming form.

\$24.5b

HOW MUCH CHINA'S ONLINE GAMING MARKET WILL BE WORTH IN 2016.

Taipei-based tech research firm Market Intelligence & Consulting Institute says that china's online gaming market is set to explode in the next year, reaching over \$24.5 billion, which is higher than last year's online gaming market in the United States. Reasons cited include a growing gaming scene, improved internet, more mobile devices and higher wages. On top of that, Sony and Microsoft will finally be allowed to sell game consoles in China from this year onward.

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XSplit Gamecaster
Streaming Software



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(optional)



Full HD IPS Wide View
Matte Display
(optional)



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technotes

» GEAR WE WANT

BRUNO SMARTCAN

\$179 | BRUNOSMARTCAN.COM

The dustpan is one of those inventions that's now hard to imagine really living without, but the Bruno Smartcan wants to make this domestic essential redundant. This smart rubbish bin has a funnel shaped base that's wrapped around a vacuum and sensor, meaning you can simply sweep your floor mess at the bin and it'll do the rest. The Bruno Smartcan also connects to an app that'll remind you when it's rubbish collection day, or when you're running out of bin liners. Now, if it relined the bin when you took out the rubbish we'd already have bought one... but we guess replacing the need for a dustpan is still impressive. **Joel Burgess**

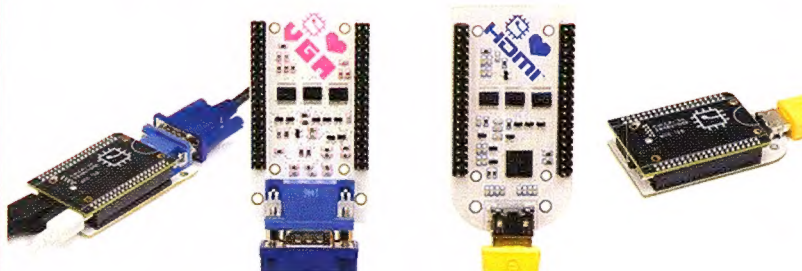


CHIP

US\$99 | NEXTTHING.CO

If Next Thing Co. wanted to follow Raspberry Pi's lead and put food, tech jargon and irony into a punny name, CHIP would be called the Big Mac. This mini-non-Apple-computer is not only tiny, it also looks and costs about the same as a hamburger. Boasting a 1GHz processor with 512MB RAM and 4GB of onboard storage, this palm-sized computer comes with Linux pre-installed allowing you to add any app you want through the open source OS. CHIP also has Wi-Fi and Bluetooth and connects to a display through either VGA or HDMI. But apart from being one fifth of the price, CHIP has another thing up on the Raspberry Pi: you can buy a battery pack, which makes it completely portable.

Joel Burgess



THE SOUND TORCH FLAMING BLUETOOTH SPEAKER

PRICE TBA | TINYURL.COM/OGJCTZB

Take one part Bluetooth speaker, one part man's lust to see everything on fire, and you have the Sound Torch. As the pyrotechnic speaker plays music, a board on top measures the sound waves and produces fire based on high and low activity areas. Basically, the more intense the music, the more fire that spurts out of the perforated top. Sensibly, it's not recommended for people under the age of 18 due to the presumption of setting yourself on fire. The speaker itself can be recharged and has a claimed battery life of 12 hours. The lighter fluid will last for four hours. **Paul Taylor**





JAWBONE UP2 & UP3

UP2, \$150; UP3, \$250 | WWW.JAWBONE.COM

Jawbone's the other big name in fitness wearables (Fitbit being the real bigwig) and we've been previously quite fond of the company's UP step/sleep trackers and associated smartphone apps. Jawbone's just launched a new pair of bands, the UP2 and UP3, with the latter packing more sensors (including heartbeat, sweat and galvanic skin response) that in theory make it a far more powerful tracker. It can now detect when you're in REM sleep, for example. Unfortunately, that heart rate sensor isn't on-demand, only automatically checking your resting rate, and it feels like half the best features are still in development. As such, right now it's hard to recommend the UP3 over the \$100-cheaper UP2. We still love the user-friendlyness of the software though. **Dan Gardiner**

XBOX ONE ELITE CONTROLLER

\$199.95 | WWW.XBOX.COM

Coming to both Xbox One and Windows 10, Microsoft's new controller has been primarily designed for (and in consultation with) pro-gamers. We've tried it and can confirm it's a premium piece of kit. Everything apart from the chassis can be customised to some degree, and even the chassis itself sports a new look and feel with slightly rubberised grips. Both sticks can be popped off and replaced with something longer or shorter, and the D-pad has a concave twin that's perfect for fighting games. On the rear, paddles can be customised to replicate other buttons, and the trigger depth can be set to long or short. Yes, it's expensive, but it's already proving itself as a sound evolution of a great piece of tech. **Paul Taylor**



ONE2TOUCH FLIPCOVER SERIES

PRICE: TBA | ONE2TOUCH.NO | ANDROID 2.3.3 +

Though an external keyboard for your smartphone may seem excessive, as phones get bigger and become more closely aligned with tablets, dedicated smartphone keyboards start to look a little more appealing. And if you type a lot of emails and notes on your phone, then you might be surprised at how useful they can actually be. The one2Touch Android smartphone keyboard case is not only astoundingly small, it uses Near Field Communication (NFC) – the same system your bank cards use for contactless payment – so it doesn't have to physically connect to your smartphone, or charge... ever. If you've been holding out for a contemporary BlackBerry, this may be just the solution. **Joel Burgess**



Computex 2015 show report

We rounded up the coolest, weirdest and most intriguing products, trends and ideas from the year's biggest PC-centric trade show.

Shaun Prescott and
Dan Gardiner report

AMD's Carrizo promises better budget laptops.

Taiwan's annual Computex show in June is one of the key events on the PC calendar. It's a great way to check out what's new and what's coming out over the next year – and also, therefore, a good way to see how healthy the PC market is in general. While this year's show could be charitably described as 'sedate' – largely due to some big product releases being pushed back to later dates – there were still some products and trends that were worth (quietly) getting excited about. Here, we've put together a quick list of the most interesting items we saw.

INTEL'S SKYLAKE IS A NO SHOW... BUT ALL THE MOTHERBOARD MAKERS ARE READY

It was widely hoped that Intel would use Computex to launch its new Skylake desktop PC platform (aka its 6th-generation Core processors and new 100-series motherboard chipset), but it was apparently not quite ready for prime time. While it's now rumoured that the CPUs won't land until August or September, the motherboard side of things seems basically ready to go, as all the major vendors had new 100-series models on display. Behind closed doors, Gigabyte showed us a near full line up of 100-series models, for example, with the top-end Z170-chipset catering to enthusiasts, and the H170 and H110



There were plenty of 100-series Skylake motherboards, but no CPUs to be seen.

pitched at the mid-range and budget segments, respectively. ASUS, MSI and ASRock all had a smattering of boards to show off as well. We're hearing good things about Skylake's performance, so if you're planning an upgrade soon we'd hold off until it's officially launched.

SKYLAKE ISN'T JUST FOR DESKTOPS

The big PC manufacturers are all obviously preparing Skylake-based boxes for release later this year, but it'll also launch on tablets, laptops and all-in-ones in 2015 too. While examples of laptops and tablets running on the new platform are basically non-existent at this stage, ASUS did use Computex to announce a new range of all-in-ones based on Skylake, with the new models dubbed simply the 'Zen



Skylake won't just appear in traditional desktops.



The customisable Roccat Nyth mouse.

AiOs'. While all-in-ones have traditionally been a little underpowered, Skylake could be the platform to change that situation – and along with improved overall performance, it includes support for DDR4, USB 3.1 and Thunderbolt 3 (which, just to get confusing, also uses the new USB Type-C connector). ASUS's 23.8-inch Zen AiO Z240IC looks like a decent all-rounder, with a GeForce GTX 960M graphics chip and the ability to house up to four SSDs. Colour us intrigued.

ROCCAT'S NEW 3D PRINTABLE MMO MOUSE

Calling the Roccat Nyth an MMO mouse isn't entirely accurate: it can be an MMO mouse, or it can be a stripped-back FPS mouse, or a MOBA mouse... basically anything you want, depending on how you choose to customise it.

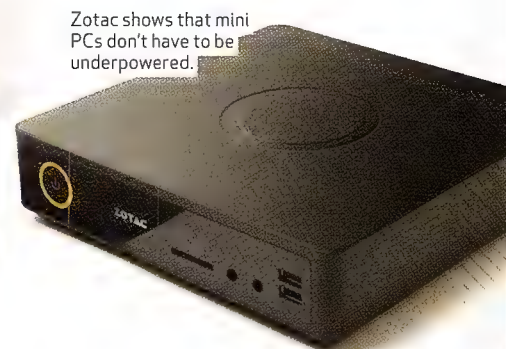
The package comes with a wallet containing 32 plastic buttons, which can be slotted in and out of the righthand side of the mouse in a variety of configurations – or you can plug the mounting holes all up and not use them as buttons at all. If you own a 3D printer, you can also 3D-print buttons to make your perfect configuration. Roccat will offer its own button variations, but if you've got the design skills you'll also be free to create your own. The Nyth comes with software for assigning the buttons using a simple drag-and-drop interface. If you want one mouse for a variety of playstyles, it's a handy piece of kit.

AMD BRINGS GAMING TO LOW-COST LAPTOPS

AMD's historically struggled in the laptop space, but the company's hoping its new Carrizo chips could change that. These sixth-generation APUs (which combine the CPU and GPU on a single die) have been engineered around bringing more gaming grunt to the mainstream-laptop space – around the \$500 to \$1,000 mark. But these machines aren't just about gaming – that new APU design also packs significantly improved battery life for things like movie streaming (double



ASRock's affordable Beeboxes.



Zotac shows that mini PCs don't have to be underpowered.

that of their fifth-gen APU forebears) and they're certified for DirectX 12 and the full Windows 10 experience. What that all means is that you should soon be able to get a great all-rounder laptop than can actually game on (at low-to-medium detail settings) for under \$1,000. That's the idea at least. At the time of print, most Carrizo machines coming to market in Australia seemed to be using AMD's higher-end A10-8700P chip and targeting a \$1,500 price point – well above what we'd consider 'low cost'.

THERMALTAKE'S CRAZY WALL-MOUNT PC CASES

PC cases traditionally sit on a desktop, and you know what? That makes perfect sense. There's no reason to stray from that convention. That hasn't stopped case, peripheral and PSU-maker Thermaltake for experimenting though. Its Computex booth was among the most impressive this year in terms of crazy PC cases. That... thing pictured below isn't a discarded Steampunk prop, but a PC case. Yes, you can actually hang your PC from a wall for all your friends to admire. While there's a thick piece of glass guarding the innards from the elements, the sides are left wide open, meaning you'll need to keep on top of dust. If you're keen to put your PC on display like this, though, it's likely any excuse to get close to your machine will be gladly taken.

EVERYONE'S MAKING A MINI PC (OR THREE)

The NUC mini-PC design that Intel pioneered a few years ago seems to have become a popular one – at least if vendor uptake is anything to go by.



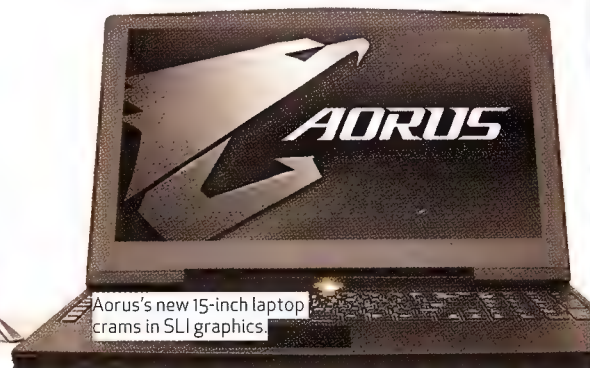
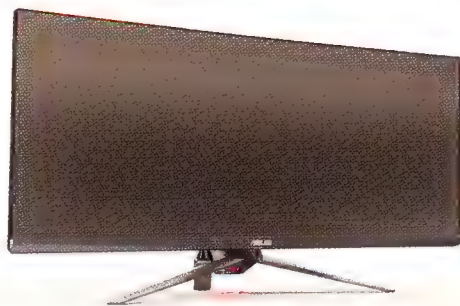
One of the gargantuan wall-mount cases from Thermaltake.

Gigabyte was quick to join Intel with its BRiX line of mini-boxes, but since then a host of other PC companies have jumped in too, with ASUS, MSI and others all producing their own versions. You can add ASRock to that list, which has announced the Beebox line of NUC-alikes, based on Intel's latest N3000 series SoCs. That means either dual- or quad-core Celeron processors... but before you write these off as being too low-powered, ASRock's tweaked its designs to allow for dual-channel memory which, even on these lower-power chips, means you'll get 4K video playback support. There's also three video outputs (two HDMI and one DisplayPort), 802.11ac Wi-Fi and an IR remote. They're expected to be available for around US\$220 – so under \$300 locally – later this year.

THE MINI PC GETS GRUNTY

Seemingly aiming to show that the NUC trend doesn't have to mean 'low powered', Zotac's EN970 aims to prove that you can (potentially) have it all in a small package. This Alienware Alpha-sized box has basically taken the guts of a high-end gaming laptop and chucked them in a chassis that can discretely sit under your TV or monitor. For gaming, the critical bit is the Nvidia GeForce GTX 970M that's under the hood, which is paired with a Core i5-5200U CPU. There's room for both an mSATA and 2.5-inch SSD too, so you won't be starved for storage, and four HDMI, two Ethernet and five USB ports take care of external connectivity. We are vaguely concerned that the dual-core CPU in this one could be a bottleneck to gaming performance,

"Yes, you can actually hang your PC from a wall!"



but we'll reserve final judgement until we get our hands on the retail product. No word yet on Aussie pricing or availability, but it'll launch in the US in November for around US\$1,000.

ASUS CURVED 34-INCH G-SYNC DISPLAY

While Nvidia and AMD may both be banging the 'gaming at 4K' drum with their latest top-end GPUs, we reckon the high-framerate (HFR) trend is a slightly more compelling (and affordable) one, with G-Sync and FreeSync monitors offering much smoother gameplay... albeit at lower-than-4K resolutions. While 4K G-Sync monitors are coming, the cost to actually use them effectively is going to be the restricting factor – you'll likely need to build a \$10,000 quad-SLI rig to generate the kind of framerate you need for HFR. ASUS could have a slightly more achievable goal in sight with this curved 34-inch ultrawide monitor, which it's pairing with an Nvidia G-Sync chip. With a resolution of 3,440 x 1,440 pixels, a 21:9-aspect ratio IPS panel and a 'frameless' design (meaning there's less bezel at the edge, for more seamless pairing of multiple monitors) and a full height/tilt/swivel stand, this could be a real sweet spot for G-Sync screens. This one's still technically in development, so pricing and release date are still TBA.

G-SYNC AND FREESYNC COME TO LAPTOPS

While it may have taken a while, there's now a good range of both G-Sync and FreeSync monitors available in the market. But with gaming laptops being increasingly popular, where're the techs at for those who'd rather go mobile? It turns out the answer is 'right here, right now' – at least on the Nvidia side of things. ASUS, MSI and Aorus all had G-Sync laptops at Computex this year, so they'll be hitting the market very shortly... and in fact, some already have. Because laptop screens interface with the GPU in a different manner, it turns out that unlike with discrete monitors, there's no need for a dedicated G-Sync hardware chip to make the tech work. As such, some existing models have been able to be retooled to get G-Sync working, such as ASUS's G751JY. AMD's also tentatively announced that it's hoping to get FreeSync working on its Carrizo-based laptops (see page 13), although there are few details beyond a 'we're working on it' promise. In the meantime, you can check out our review of the retooled ASUS G751JY on page 27 for more details on G-Sync on laptops.

COOLER MASTER THINKS YOU'RE A UNIQUE SNOWFLAKE

Customisation and personalisation is one of the key principles of PC gaming, but no one looks to be taking the concept as seriously as Cooler Master. The company unveiled its 'Master Concept' case at Computex, which boasts a new 'FreeForm Modularity System' for PC cases. In words we can all understand, that basically means a PC case that is thoroughly customisable, with individual components and their dimensions created in response to community demand. You'll be able to choose from three versions of the case at retail, and further customise your one by going to a dedicated online shop and ordering individual parts. It's not all about aesthetics: the FreeForm concept also allows ease-of-access to your machine's innards. And the company's said this is just the start of its customisation efforts: it wants to weave this

philosophy through the rest of its products, too. It'll be interesting to see if Cooler Master's rather gutsy technology actually catches on. On a showroom floor where fancy, customised PC cases are the star attraction, there's a good chance it will.

AORUS BUILDS A RELATIVELY SEDATE DUAL-GPU LAPTOP

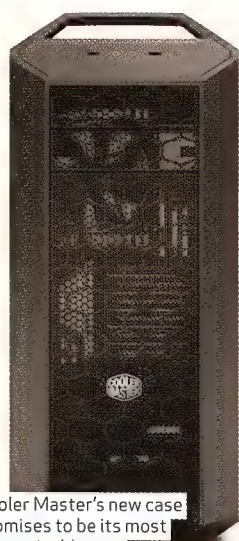
Aorus is Gigabyte's dedicated laptop brand, and it's one that the company is hoping will be synonymous with a less blingy form of gaming laptop. Basically, Aorus designs are meant to be a little bit classy, and the Aorus X5 is perhaps the perfect showcase for this philosophy. One of the main reasons you'd get the X5 is the dimensions. We dread carting around our monster laptops, but the X5 weighs a relatively slight 2.5kg and isn't as ostentatious-looking as say, an Alienware or MSI equivalent. But under the hood there's plenty of power with two GTX 965M GPUs. And physically, it comes in at 390mm wide, 272mm deep and 22.9mm high. The fully backlit keyboard boasts individual macro keys and is refreshingly economical, but the big news is that the rig is also fully G-Sync ready.

CCP VIRTUAL REALITY DEMOS

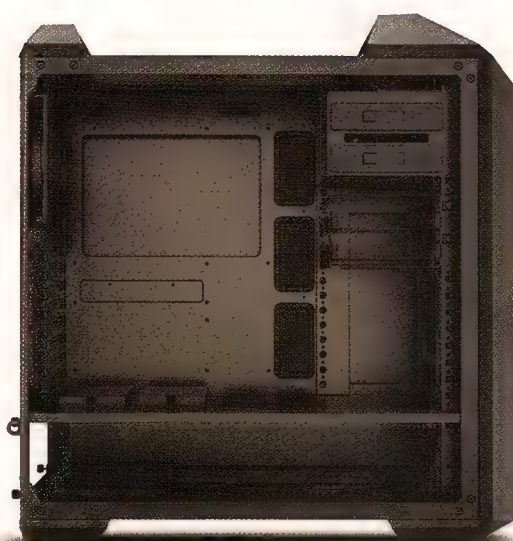
While *EVE Valkyrie* is game-developer CCP's flagship foray into VR, the studio is also working on a bunch of R&D demos under the mantle Hydra. Among these is the aptly-titled Disc Arena, which has two players tossing lethal frisbees at each other in front of jury-rigged Kinect 2.0 sensors. Each player stands stationary on a small podium, equipped with a translucent shield capable of both blocking and deflecting the discs. Think a violent, immersive 21st century Pong.

Frisbees generate in your right hand every 10 seconds or so, and during our five minute demo there were often three or four crazily bouncing around the room at a time. It's a well-executed glimpse into the type of full-body gameplay VR will eventually be capable of.





Cooler Master's new case promises to be its most customisable ever.



We'll see more discrete laptops that can game.



VR got a quick look in at Nvidia's demo area.

GAMING LAPTOP OR NOT A GAMING LAPTOP?

If you want to game on a laptop but don't want a 'gaming laptop', then aren't you bloody picky? Lucky for you, though, there are more and more PC

makers willing to accommodate you... if you're prepared to make a few sacrifices. Gigabyte's P55W v4 is a 15.6-inch laptop boasting a GeForce GTX 970M. Efforts have been made to make the P55W v4 an all-rounder: unlike the Aorus brand it doesn't look like a gaming laptop (even though Aorus's designs are pretty modest in their category), and while you won't want to carry it around all day with a weight of 2.4kg, it'll be manageable from point A to B. It's got a 512GB SSD, a new Core i7-5700HQ processor and a backlit keyboard. Gigabyte isn't the only company tackling this market: MSI's Prestige series is a competitor, though Gigabyte's specs looked a little better at the time of print.

ASROCK GOES INTO NETWORKING

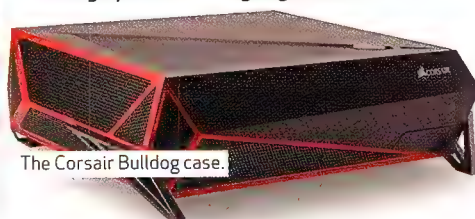
Routers aren't perhaps the most interesting pieces of kit, and it's unlikely that anyone at Computex would flock to see the launch of a new one. Motherboard-maker ASRock has different ideas however, with the new G10 router resembling a Soviet monument more than a discreet grey case you keep hidden in a corner.

Geared towards gamers, in ASRock's words the G10 is a "4T4R router with 8 dipole high power antennas". That basically means that it's an 802.11ac model that's capable of reaching Wi-Fi speeds up to 1,733Mbps and packs the latest wireless transmission techs including beamforming and MU-MIMO. As a magnificently oddball bonus, it's also got a removable travel router slotted in the top (for sharing mobile broadband connections while out and about), which thanks to an HDMI plug can also double as a Miracast receiver, letting you mirror your PC or smartphone screen on your TV. All things considered though, the G10 is just a damn fine looking router... not a sentence we ever expected to write.

CORSAIR GOES FOR THE LOUNGE ROOM WITH BULLDOG AND LAPDOG

What ever happened to Steam Machines? They're definitely coming – Valve has a storefront on Steam dedicated to them – but the chatter has definitely died down. Whatever the case, Corsair is still taking the living room PC concept seriously, and the company seems reluctant to make any compromises. Its Bulldog and Lapdog products aim to work in concert to (hopefully) deliver a true PC-gaming experience from your couch. The Bulldog case aims to let you build a fat and totally liquid-cooled PC, while the Lapdog is – as the name suggests – a big lap tray with a slot for your keyboard and mousemat on the side. It's big. Everything about these products is big, but for gamers reluctant to make the concessions required for a living-room PC – and for those reluctant or unable to consider streaming – this could be among the better options out there.

APC's journalists attended Computex courtesy of AMD and Gigabyte.



The Corsair Bulldog case.



ASRock is venturing beyond motherboards into networking.

technotes

HOW IT'S DONE



Oculus Rift DK2

Inside virtual reality.

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.

BACKGROUND

A new paradigm in PC gaming? Yet another false dawn for virtual reality? Or nothing more than a tool to accelerate Facebook's social media hegemony? Just what to make of the Oculus Rift? Torn asunder here in heavily revised Development Kit 2 format, one thing is for sure – the device is fast approaching retail status.

MAJOR TECH SPECS

- Low-persistence 5.7-inch Super AMOLED display with a resolution of 960 x 1080 per eye.
- Accelerometer, gyroscope, and magnetometer with an update rate of 1000Hz.
- Positional tracking via external camera with near-infrared CMOS sensor.
- Built-in latency tester.
- 100 degree field of view (a significant upgrade from DK1).

KEY FINDINGS

- Oculus Rift Development Kit 2 shows some noticeable streamlining in size and shape. Opening the treasure chest, we get a glimpse of a single motherboard, not the tiny multiple boards of the original Oculus Rift, eliminating the need for an external control box.
- The main display has a rubber case housed in a plastic backing. Inside the rubber casing is – drumroll please – the full front panel of a Samsung Galaxy Note 3 smartphone featuring a 5.7-inch Super AMOLED 1080p screen. Even the Synaptics S5050A touchscreen controller is intact.
- Oculus claims the DK2 display is a low-persistence OLED screen capable of a 75Hz refresh rate. This means Oculus is overclocking the Note 3 display panel from its stock 60Hz, allowing smoother motion.
- The DK2 includes a new positional tracking unit. It's an external IR camera specially designed to work

- with the new Development Kit. You can't substitute an old webcam, nor retrofit the tracking to DK1.
- Within the faceplate, we find two new and improved lenses, which have increased in size to accommodate a wider IPD (interpupillary distance) range. For those gamers who sport geek-chic glasses, the Oculus team has included different eyecups of varying focal lengths, just like it did in the Oculus VR, though this isn't a perfect solution.
 - Repairability Score: 9 out of 10 (10 is easiest to repair). Standard Phillips screws are used in both the headset and positional tracker, making them a cinch to open. Cable management is much improved, and the elimination of the control box makes for a simpler, more streamlined device. The use of a common smartphone display means replacement parts are readily available. Given that the Rift is still a beta product, this is still a preliminary score – but things are looking good. ■

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» EPINIONS

There are things that belong in the wash and things that don't.



SEPARATE THE WHITES

It's about time I tell you a story that took place a few months ago. Essentially, I did exactly what one of your staff members wrote about – his Fitbit tracker accidentally going through the wash. I accidentally put my SanDisk Cruzer 32GB in the wash! When I found it afterwards, I panicked and blew the water out of the connector and plugged it in – it was still working! I promptly did a backup, then pulled apart the case to see the damage. To my surprise, the water had hit the red plastic that you use to slide the connector out and only really leaked into the inside of the black case, with only one drop of water on the flash memory on the back! I dried it, and left the board and case parts sitting out overnight, then put it back together the next morning.

A week passed... still working... a second week passed... still working! It's over four months now, and the drive is still going strong, so it's safe to say that the little drive somehow survived the wash without a scratch! So I thought I'd share this with your readers, it isn't every day you find your previously washed USB still works! And for the record, I had a USB die on me for the same reason a few years back, only that one had a tough leather cover on it. So much for protection that time...
Jean-Luc Mackail

SURPRISINGLY, THE ORDER MATTERS

In APC issue 416 the Quick Tip on enabling AHCI after installing Windows 7 prompted me to check my newly installed SSD with Windows 8.1 64-bit. Yes, the BIOS setting was still IDE. After hours of trying the Registry fix, numerous reboots and then much Googling it turned out that the Windows 7 fix did work for Windows 8.1.

For Windows 8.1 the registry settings to be checked and changed if necessary are: HKLM\System\CurrentControlSet\Services\storahci set start to 0 and also HKLM\System\CurrentControlSet\Services\storahci\StartOverride set 0 to 0

Interestingly, even though I was using an administrator's account the changes to the registry were not saved. I had to run regedit as an administrator to get the changes to stick. Also, after a successful reboot the StartOverride key in the registry disappeared.

The AS SSD test score for my SSD improved by about 70% and the TRIM function should now work. Worth the effort, I'd say.

Carl Jackson
(APC reader since Issue 1)

BACKUP EVERYTHING?

I read an excellent recent article on encryption and I want to give it a go. The article unfortunately fails to point out if SyncBack will backup the encrypted volumes too? It would be most helpful if you could disclose this information.

Gunther Jank

Ed reply: Glad you liked the article! Regarding your question, it should be fine to back up the .sdsd files that SafeHouse Explorer creates with SyncBack (or any other backup program, for that matter), but you'll need to make sure the .sdsd's encrypted 'volume' isn't open and/or in use at the time. If it is open, SyncBack may not be able to read the .sdsd correctly.

JUNE ISSUE

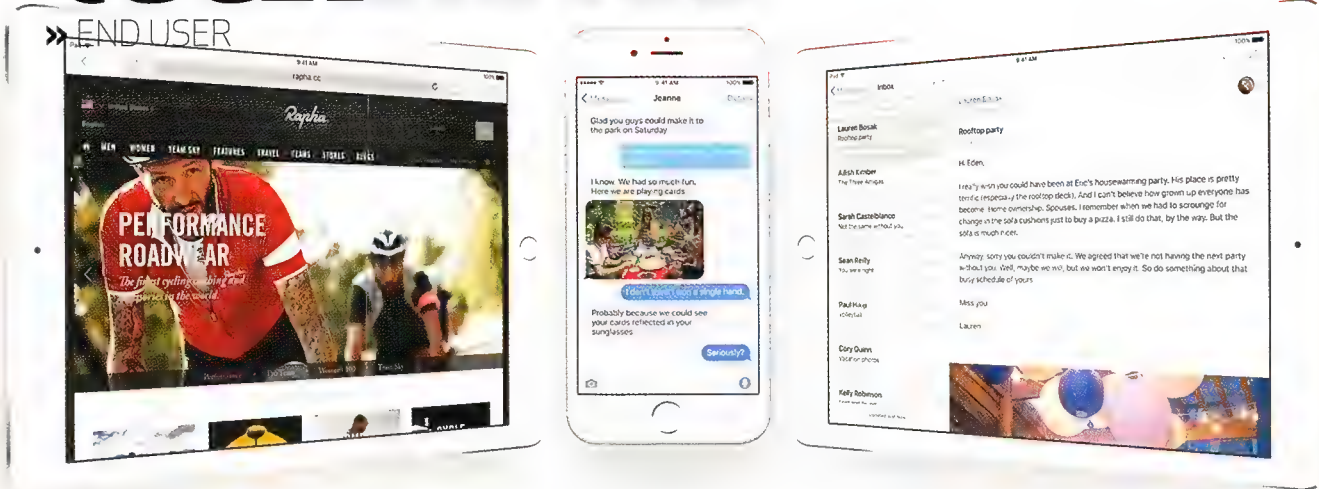
I loved the hardware reviews and articles on the Pi and ARM based modules in your June issue. They have brought some excitement, and hacker enthusiasm, back to the computing world. The ability to customise so many possible projects is truly stunning. Nice issue.

Mark O'Farrell ■

APCMAG@FUTURENET.COM

Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.



Apple to adopt ad-blocking in iOS 9?

Is this the death of ads on the world wide web? Joel Burgess

At Apple's recent WWDC conference in San Francisco, the company introduced something massive. Instead of announcing it on stage, however, the revelation was hidden away in the developer notes of the iOS version of Safari 9.0. The controversial new feature is an inbuilt 'Content Blocker' pathway, which will allow third-party ad-blocking-apps to bind to Safari and potentially prevent any ad script from running anywhere on the entire web.

What's drastic about this is not just that Content Blocker will allow pervasive blocking (automatically cutting ads without any triggering), but it's also the first example of web ad-blocking on a mobile or tablet.

You may think that mobile web usage is insignificant (and in terms of total data consumed this is still likely the case), but according to the global analytics firm ComScore, in terms of platforms used to access the web, mobiles and tablets overtook fixed internet access last year to become the most common platform. And on mobile, Safari is the top web browser in Australia, accounting for around 60% market share.

Numerous online media outlets are outraged by Apple's recent move and it's

easy to understand why, with advertising revenue largely paying the wages of online journo's. But are these blowups about Safari's new ad-blocking feature really justified? Like with every controversial issue, there's always a flip side — and it's not just coming from people decrying the fact that ads are almost always annoying.

The statistics about mobile web surfing numbers, for example, are a little wobbly. According to Nielson, for example, only about 11% of mobile web time goes through dedicated web browsers — the other 89% comes through apps. If those apps don't use Safari to open web pages, the immediate effect could be smaller than estimated.

There's also some people reasoning that if content blockers are available on mobiles that this will force web advertising to be less invasive. That's nothing more than speculation, however, and it leaves all sorts of other questions unanswered — like who decides what counts as 'intrusive' (Apple?) and whether any users would actually turn web ads back on after having lived without them.

Then there's the moral argument. While blocking web ads might feel different to ordering a coffee and running off without paying, that's

pretty much what it is. The sites you visit depend on web ads for revenue, so by blocking them you may be starving the very sites you enjoy. What's potentially at play here, then, is whether or not the user will lose out in the long term, as online publishers die or change for the worse from lack of direct ad revenue.

The only indicator we have to go by is the 6-year history of Adblock, which started as a Chrome browser extension and has since grown into the most popular multi-browser web extension ever, with over 40 million users. And considering it'll block everything from popups to YouTube video ads, it's no mystery why it's popular. But despite accepting donations from adoring users, somewhere along the way Adblock also developed a whitelist of ads that it's creators have deemed as OK to display. For the most part, that whitelist is free to join for sites with non-invasive ads, but according to the Financial Times, it also accommodates ads from Google, Amazon, Microsoft and Taboola in exchange for hefty fees.

If a weeny extension company can push around big names like Google and Amazon, what are the ramifications of Apple having that same power over advertising and content. Is that something we really want? ■

ENDUSER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.



A real pocket rocket

THE SAMSUNG PORTABLE SSD T1 IS THE ULTIMATE IN PORTABLE STORAGE.

Designed for creative professionals and demanding business users on the go — or anyone who just wants a slick and speedy storage device — the Samsung Portable SSD T1 houses up to 1TB of Samsung's class-leading solid-state NAND flash memory in a very compact package. And with USB 3.0, there's no bottlenecking when you're copying data to and from your PC. It's the no-compromise storage device that combines amazing features with a sleek and stylish package.

FAST

The Samsung Portable SSD T1 is built from the ground up for speed. Taking advantage of Samsung's extensive SSD know-how, the T1 range offers read and write speeds of up to 450MB/s* — that's up to six times as fast as a regular mechanical hard drive. That means it's fast enough to tackle almost any storage-intensive task you can throw at it. Whether you're editing 4K video or just looking for the quickest loading times in games, the T1 won't leave you waiting.

SAFE

When it comes to data security, the Samsung Portable SSD T1 also has your back. With virtually uncrackable hardware-based 256-

bit AES encryption onboard, you can protect your data from prying eyes. And when you want to access your private files, it's just a matter of entering your password. It's not just encryption that protects your data either. With solid-state technology, the T1 doesn't have any vulnerable moving parts, meaning it's much better-equipped to stand up to the rough-and-tumble that portable drives inevitably experience.

STYLISH

Samsung hasn't compromised in the style department either. With a classy and sleek black polycarbonate chassis, the T1 packs all that storage and speed into a package that has a footprint that's around two-thirds the size of your average business card. Images don't do justice to how compact the T1 really is: you need to see it in person. This is an elegantly-designed drive with a thin profile and, weighing in at a tiny 30g, it can easily slip into a shirt or pants pocket without being a burden.

In short, the Samsung Portable SSD T1 delivers a mass of speedy storage that comfortably fits in the palm of your hand, all based on Samsung's trusted SSD expertise. With the T1, Samsung hasn't compromised — so you don't have to either.

SPECIFICATIONS
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WEIGHT
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WARRANTY
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*Performance benchmark product: T1 (500GB). Performance can vary depending on host configuration and test software.

**Users can select security option during the initial registration process (For more details, please refer to the manual).

*See <http://www.samsung.com/au/support/warranty> for further information

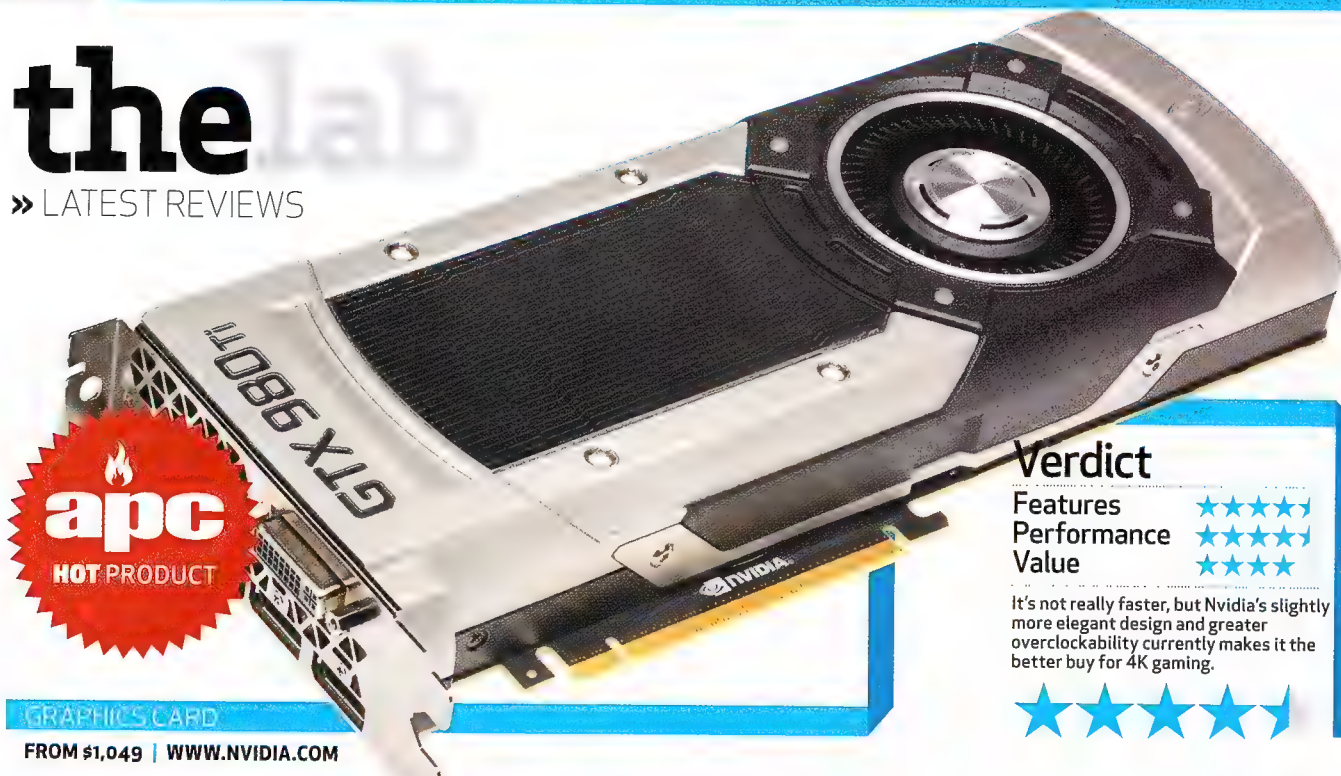


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Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

It's not really faster, but Nvidia's slightly more elegant design and greater overclockability currently makes it the better buy for 4K gaming.



4K gaming on the cards

Nvidia and AMD are both pushing their new flagship graphics cards as the kit to get for 4K gaming. Jarred Walton and Dan Gardiner run them through the ringer to find out which holds up best.

Nvidia was first off the blocks with its '4K' card, releasing the 980 Ti at the start of June, so that's where we'll start.

Rather than being a clocked-up GTX 980, it's best to think of the 980 Ti as cut-down Titan X. It's based on the latter's GM200 architecture and the main difference in the two is that the 980 Ti packs two less of Nvidia's 'streaming multi-processors', dropping the total count from 24 to 22, and there's a resulting drop in CUDA cores from 3,072 to 2,816. Otherwise, the GPUs are very similar: both have 96 ROPs and a 384-bit GDDR5 interface.

MORE MEMORY

The other key difference with the Ti and the Titan X is memory: there's 6GB of VRAM on the new card, down from 12GB on the Titan. We're already seeing signs of 4GB VRAM being insufficient at 4K, but most games don't get anywhere near needing 12GB; 6GB is a

decent midpoint. All up, that means in situations where games don't need more than 6GB VRAM, the 980 Ti should be no worse than 8% slower than the Titan X while being around 15–20% faster than the GTX 980. In situations where the VRAM amounts come into play (e.g. at 4K resolutions), the performance delta will potentially be even greater.

While the basic design of Nvidia's first- and second-generation Maxwell parts is the same, it's worth noting that only 2nd-gen Maxwell processors support several of the newer features: DSR, third-generation Delta Colour Compression, Multi-Pixel Program Sampling, VXGI, VR Direct, Multi-Projections Acceleration, and MFAA. HDMI 2.0 is also supported on 2nd-gen Maxwell, which means you can drive a 4K monitor without resorting to any compression algorithms.

DESIGN AND PERFORMANCE

The GTX 980 Ti reference design retains Nvidia's

proven cooling solution from the Titan X and earlier GPUs, but unlike the latter, third-party card makers are allowed to produce custom cooler designs. Still, the reference cooler works well, managing to provide good cooling without generating a ton of noise.

And just as expected, the GTX 980 Ti is also a force to be reckoned with in our benchmarks. For those with an older GPU like the GTX 770, the GTX 980 Ti represents an astounding doubling of performance at our 1080p and 1440p settings. If you happen to run 4K games at maxed-out settings, we actually averaged more than a 3x improvement in performance.

That said, if you already have a good GPU, the 980 Ti isn't going to provide nearly as much benefit. Compared to the 970, it's a reasonable bump in performance of 55–65%, but against the GTX 980, at stock speeds it's a much smaller 20–25% improvement.

OVERCLOCKING CAPABILITIES

That said, like its other Maxwell cousins, the 980 Ti proves to be a good overclocker – so much so that both the retail cards we've tested this month come with a healthy 15% overclock out of the box. And we found you could generally push that a bit further – enough to go from the low 30s to a far more comfortable 45–50fps.

AMD GETS FURY-OL'S

On paper, AMD's answer to the 980 Ti looks great. The Fury X packs 30% more shaders than its R9 290X predecessor (up from 2816 to 4096) and as the first GPU to use AMD's new Fiji design, it comes with the company's brand-new High Bandwidth Memory interface. This is theoretically a big step up from the 7-year-old GDDR5 and should decrease bottlenecking when it comes to getting data to the GPU.

Based on specifications and initial reports, we had high hopes for the Fury X



GRAPHICS CARD

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Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

A good first step for AMD's new Fiji architecture, and one that should hopefully improve as the drivers mature.



configuration with a liquid cooler, so that's not likely to improve by opting for a different brand. Given that cards from ASUS, MSI and Gigabyte seem to be coming factory-overclocked to 10-15%, that ultimately gives the 980 Ti a 10% or more performance lead.

— though there were always a few concerns, the biggest stemming from the new memory configuration. HBM uses a silicon interposer, sort of like a simplistic microchip, to route all the traffic from the memory modules to the GPU. The catch is that these silicon interposers need to be made quite large — enough for the GPU core along with the HBM modules.

And Fiji is a big GPU core to begin with, meaning the interposer is effectively as large as it's possible to manufacture. The net result is that while in theory it should be possible to use up to eight memory modules with Fiji, space constraints have limited AMD to four on the Fury X. Since each module for HBM 1.0 is 1GB, that means you're limited to 4GB total graphics memory — less than the new R9 390/390X and the GTX 980 Ti. If you run games at settings and resolutions that exceed 4GB VRAM use, performance could suffer.

THAT LIQUID COOLER

While the Fury X card is fairly compact (7.5-inches long) it's conspicuously attached to a 120mm radiator — which increases the space requirements substantially. Pretty much every enthusiast case sold in the last 2 years will support a 120mm radiator, but this does result in more case clutter than a regular HSF.

Also worthy of note is that AMD's dropped DVI output from the Fury — you'll only find three DisplayPort sockets and one HDMI. The latter's not HDMI 2.0 capable either — and thus, there's no support for 4K@60Hz over anything but DisplayPort, making it a less-appealing option for media PCs than Nvidia's Maxwell 2.0 cards.

SPEED CHECK

With Fury X cards priced the same as 980 Tis (around a grand in Australia), the proof should really be in the performance. But here the Fury is a bit of a mixed bag. While the water cooler keeps

the thermals very healthy, topping out at 65°C the overall system power draw from our Fury X test bed was higher than we saw from the 980 Ti — 442W compared to 378W. And in terms of sound, while the water cooler's radiator fan is virtually silent, there is a faint but higher-pitched squeal when you're gaming.

When it came to frame rates, the competition was much closer. In many tests across 1080p, 1440p and 4K the difference was often less than 1 frame per second — and at 4K in particular, there were only a few instances where the gap widened to over 5%. And because these wins happened on both sides of the fence it's impossible to call either the outright winner.

When overclocking, on the other hand, the Fury X proved a little disappointing, netting only a 7% core clock increase. And while multiple vendors will be selling Fury X cards, they'll all be running the reference

WHERE TO NOW FOR FURY?

The Fiji architecture is the first new high-performance architecture for AMD since Spring of 2013. (We don't count Tonga, as it was effectively a lateral move from Tahiti.) AMD has had plenty of time to improve its drivers on the Hawaii architecture, but Fiji changes the playing field. Not only does it sport a third more shaders, but it also has a different memory subsystem. 512GB/s of bandwidth is all well and good, but if latencies and other elements have changed compared to GDDR5 — and they almost certainly have — previous "best practice" driver code from AMD may no longer be properly tuned. That means that, while the Fury X may now have won this first round of the competition, that could definitely change as AMD's developers master the new architecture they've built. The fight for 4K, then, is one that's far from over. ■

TEST RESULTS: 4K GAMING PERFORMANCE

	GIGABYTE GV-N98TG1 GAMING-6GD	MSI GTX 980TI GAMING 6G	NVIDIA GEFORCE GTX 980 TI (OEM)	AMD RADEON R9 FURY X (OEM)	NVIDIA GEFORCE GTX 980 (OEM)	MSI R9 390X GAMING 8G
BATMAN: ARKHAM KNIGHT	52	52	47	45	36	34
GRAND THEFT AUTO V	63.4	64.6	58.9	57.8	45.3	42.9
MIDDLE-EARTH: SHADOW OF MORDOR	52.41	52.45	49.13	48.24	37.26	42.58
THERMALS AND POWER						
IDLE POWER DRAW	45°C	46°C	26°C	27°C	31°C	55°C
PEAK POWER DRAW	66°C	70°C	85°C	65°C	80°C	74°C
IDLE GPU TEMPERATURE	66W	71W	64W	69.5W	51W	63.2W
PEAK GPU TEMPERATURE	431.1W	390.8W	377.2W	441.8W	286.9W	507.9W

Notes: All gaming test results are in average frames per second at 4K resolution using each game's highest details settings, with the exception of GTAV, which used a custom 'High/Very High' settings profile.



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MSI GTX 980Ti Gaming 6G

A well-balanced all-rounder for 4K gaming.

Out of the box, MSI's 980 Ti comes with a factory overclock, bumping the core and memory up from 1,000/7,000MHz to 1,178/7,096MHz. That nets you a good 10-15% boost in most games over a standard 980 Ti, and up to 35% more than a GTX 980 at 4K resolution.

MSI's grafted its new generation of Twin Frozr cooler – this is the fifth iteration – onto Nvidia's GPU, and like its previous Gaming branded cards (the company's top-tier models) you get high-quality electrical components throughout plus a 6-month license for the XSplit live game streaming app. As we've previously seen, that cooler design is both quiet and efficient – it never gets above a low hum, even at 4K. Idle temps were a reasonable 46°C and it peaked at 70°C. It's worth noting that, as with most other Maxwell-based Nvidia cards, the fans on this cooler won't spin up while the GPU is idle – the

heatsink is doing enough to dissipate the latent heat. And speaking of airflow, MSI's included three built-in fan/overclocking modes (Silent, Gaming and OC). There's not a huge difference between Gaming and OC, but Silent mode down clocks the GPU to 1,000MHz to ensure the fans run at a very low speed. MSI's bigger cooler comes with a slight cost: you need two eight-pin PCIe power plugs to run the card. The rear outputs are identical however, with three DisplayPort, one HDMI and one DVI. What helps MSI's card is that it's substantially less expensive than the Gigabyte (right) – so if you're not overclocking, this is still a great implementation of Nvidia's top-tier enthusiast GPU. ■ Dan Gardiner

Verdict

Not quite as overclockable, but is slightly more affordable and has good acoustics. Easy to recommend.



GRAPHICS CARD
\$1,099 | WWW.GIGABYTE.COM.AU

Gigabyte GV-N98TG1 Gaming-6GD

This one's for the overclockers.

This overclocked 980 Ti from Gigabyte also impressed us. But the cooler is huge, with four fat 8mm copper heat pipes and three fans to dissipate heat – there's more metal, but also more weight, with the GV-N98TG1 sitting at 1.24kg vs the MSI's 1.08kg.

That said, while the 980 Ti has three fans, they're a little smaller than the MSI's, so when they spin they're louder. During prolonged tests at 4K, we found they could emit a slight whine. Gigabyte sent us a revised BIOS just as we were going to print, which was aimed at improving acoustics, so the problem may well be fixed by the time you read this. Like the MSI, there's also a dedicated Silent mode. The fans and heat pipes are efficient, keeping the card under 66°C. What's more, the GPU and memory proved decently overclockable. We got an extra 140MHz on the default 1152MHz clock speed (1,292MHz) and an extra 400MHz on the

memory (7,410MHz) with only the requirement of a little over voltage (37mV). The MSI wasn't too far behind with the same overvoltage settings (1,272/7,296GHz) but strangely, it's real-world gaming speeds weren't as good after overclocking. Conversely, the increases we saw with the Gigabyte were directly linear – cranking core and memory speeds by 10% saw a roughly 10% increase in performance. Gigabyte's overall design seems to be a bit better at keeping the 980 Ti's core clock running at its highest boosted speeds. There's always a bit of luck involved in overclocking, but based on our tests, you may well be able to recuperate this card's extra 10% cost back, after some tweaks. ■ Dan Gardiner

Verdict

It may cost a smidge more, but this one's impressive design will be a boon for those looking to overclock.



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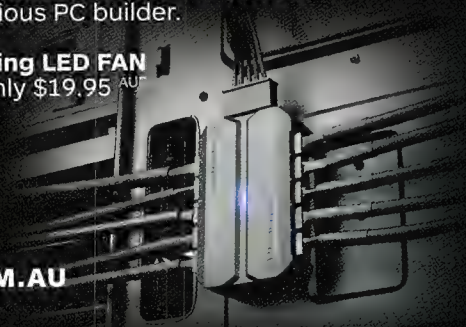
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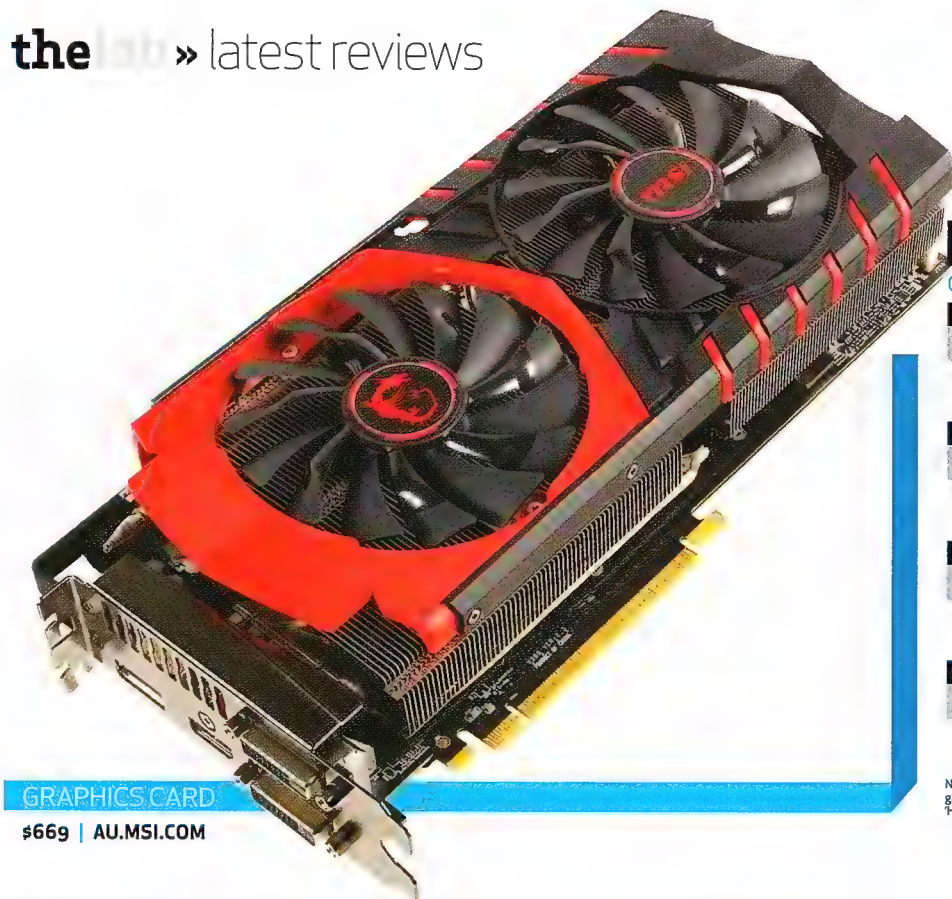
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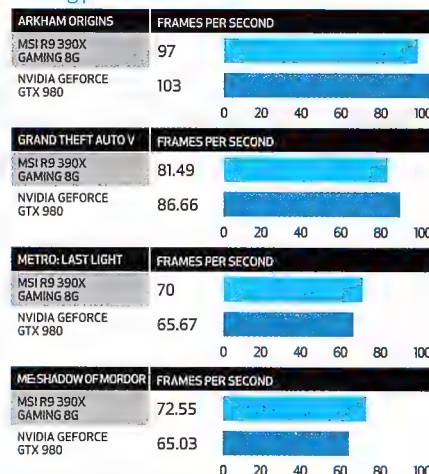


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LABS BENCHMARK RESULTS

Gaming performance



Notes: All results are average frames per second at 1440p resolution and each game's highest details settings, with the exception of GTAV, which used a custom 'High/Very High' settings profile.

MSI R9 390X Gaming 8G

AMD goes back to Hawaii for its 'new' mainstream flagship.

A step down from the Fury X, AMD's pitting the R9 390X – its new mainstream flagship GPU – against Nvidia's GeForce GTX 980. And priced at around \$100 cheaper, it just might have what it takes to seal the deal.

There are some caveats to the 390X, however. This is based on the same Hawaii architecture as the 200-series – not the newer Fiji silicon used in the Fury X on page 24. In fact, for its entire 300-series line up, AMD's essentially just gone back and retooled all its 200-series cards, occasionally bumping clock speeds and adding more and/or faster GDDR5 RAM. Looking purely at specs, it's clear how similar the two cards are: both are based on a 28nm lithography, have 2,816 shaders and 176 texture mapping units. There are bumps in core and memory clock speeds – up 50MHz and 250MHz respectively to a 1,050MHz core and 1,500MHz memory

– which are where the obvious performance gains largely come from. AMD's made some design tweaks to ensure this new design is fully DirectX 12 compliant, but Hawaii's key flaws – namely that it's power hungry – otherwise carry through to the 390X.

In fact, the latter are something that's made clear just from glancing at the design of this MSI model. With a honkin' great 2.5 slot-width cooler the whole thing weighs in at a hefty 1.3kg. To be fair, MSI's Twin Frozr V design does keep the card temperatures down to an impressive 74°C when under load (we've seen 290X's reach 90°C), but the twin fans can become audible when they kick into top gear, like when you're gaming at 4K.

And the 390X will let you play at 4K – though only just. Stocked with 8GB of memory as standard, it mostly manages to scratch out frame rates of above 30fps in modern games – although there are certain games

where the GTX 980 and its 'lowly' 4GB outdo the AMD card. In fact, at 4K resolution, who's faster seesaws back and forth between the two depending on the game you're testing. And if you're serious about 4K then the Fury X or 980 Ti are better choices, able to eek out a critical 25% speed boost.

At lower resolutions the story is a little clearer, with MSI slightly-overclocked design typically pulling ahead of a stock-clocked GTX 980 by a few percent. Honestly though, there's not much in it, and there's a game or two where the 980 can be up to 20% faster.

But then there are the power bills to worry about. To get that slight edge, the 390X pulls over 40% more power than the GTX 980. Our Intel test system drew up to 507W from the wall when running games on the 390X, for example, whereas the 980 never got over 290W. And if you game a lot, that extra power draw could eat up any initial saving you make when buying a card.

In short, while MSI's 390X does largely match the GTX 980 (and at a substantially lower price), this is an undeniably ageing hardware design – and AMD's really pushed it to get the performance where it needs to be. While that means that AMD's bought itself some more time to get its mainstream Fiji (aka Fury) cards sorted, it's worth pointing out that the Hawaii XT 290X was released way back in October 2013. While that's perhaps a good indicator of the architecture's longevity, it's hard to see it holding up as well for another 18+ months. ■ Dan Gardiner

Verdict

Features
Performance
Value



While this is an impressive retooling of AMD's existing 290X design, it needs serious cooling and draws lots of power.





\$3,599 | WWW.ASUS.COM/AU

ASUS G751JY

G-Sync in a laptop? What devilry is this?

Stuff that's great for desktop gaming doesn't always fly for portable PCs. Like 300-watt graphics chips. Or 40-inch 4K monitors. In other words, there are limitations that come with compact form factors. One of those, you might have thought, is Nvidia's frame-smoothing G-Sync technology. After all, G-Sync requires a special controller module in desktop monitors. Wouldn't that be tricky to package in a laptop?

Very probably, but we'll never know. Because you can now have G-Sync in laptops without the G-Sync scaler. The ASUS G751JY is proof. Courtesy of a newly released software update, this lappy is fully G-Sync capable. That's right, a software update. If you're wondering whether that means the whole special scaler thing was a bit of a scam, the explanation is that laptop

displays aren't like desktop monitors. They're controlled directly by the GPU. Actually, it's a little more complicated. There is an interface that sits between the GPU and a laptop LCD panel. But the bottom line is that GPUs have more control of the panel in laptops, critically, they have enough control to deliver the full gambit of G-Sync features and functionality. The two most important of those features are frame syncing and adaptive overdrive. The first aligns the frame output of the GPU with the refresh rate of the screen, and thus eliminates both screen tearing and stuttering. As for adaptive overdrive, it allows overdrive technology to function in parallel with frame syncing. Overdrive improves panel response by supercharging pixels with excess voltage. That's important as we learned from our experiences with AMD's rival Freesync tech. It

lacks overdrive support and does nasty things to pixel response. Anyway, right now, this new mobile iteration is compatible with about half a dozen laptop models running Nvidia GeForce GTX 980M, GTX 970M and GTX 965M GPUs. The ASUS G751 sports the 980M, which is a slightly cut-down version of the GM104 Maxwell chip in the desktop 980. With around 1,500 shaders, it's a great match for the 17.3-inch 1080p LCD panel. Also worth noting is the G751's 75Hz panel refresh rate. It doesn't sound like a massive step up from the standard 60Hz. But it makes a difference. Put the 980M together with G-Sync and 75Hz, and you've got yourself a splendid gaming portable. Better still, the 17.3-inch IPS screen is about as good as portable panels get, too. Meanwhile, if this ASUS looks familiar, it's because we've seen the ASUS G750 series previously. Its core talents remain the

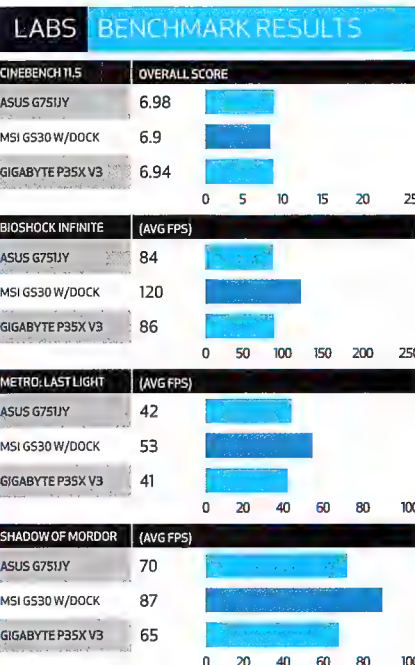
same. It's a sturdy mobile. The keyboard is solid and the chassis feels up to a few knocks. The trackpad is nicely proportioned and has actual buttons rather than pseudo button areas. We like that. That said, the trackpad is laggy as hell, so even when not gaming, you'll want to use a USB mouse. Bung in a quad-core CPU, a Samsung M.2 SSD and a metric tonne of memory, and you have one hell of a portable. But very likely at one hell of a price (there are plenty of variations available).

Jeremy Laird

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Lovely screen; super smooth gaming; solid build quality; but not exactly cheap.





Dell Chromebook 11

It's the toughest Chromebook we have ever seen, but does that make it good?

The Chromebook 11 looks more like a business laptop with its understated looks, but Dell claims its purpose-built design means that it should survive drops, water spills, dirt and dust and most things that a school environment might throw at it.

Unlike ASUS, which is trying to reinvent the Chromebook category with its 360-degree hinge on the Flip, Dell is taking a more measured approach in creating a durable product that will survive daily student use and abuse.

Because of the rugged construction, it ends up slightly larger and heavier than the competition, but is still light enough for to carry around all day.

Dell claims that its new model passes US Military Standard testing for durability, dirt, dust, pressure, temperature, humidity, shock and

vibration "so it can handle student life."

To meet those durability claims, Dell cloaks its Chromebook 11 in a solid, matte-black plastic case, a design choice that hides scratches, dirt and fingerprints well. A rubber bumper along the edges also helps shield the notebook in case it's dropped.

On this model, the touchscreen display is an optional upgrade, and it allows another means to interact with the Chromebook beyond the keyboard and trackpad.

Another feature that sets this apart is the reinforced barrel hinge. Not only does the hinge allow the lid to be opened up to 180 degrees for better peer-to-peer collaboration, it's also extremely sturdy. As students are likely to often grab and carry the Chromebook by the lid, the barrel design helps to reduce stress and prevent the hinge

from breaking. The hinge also houses loud, forward-firing stereo speakers.

The non-backlit keyboard is surprisingly pleasant to use. With almost full-size keys typing is comfortable. The keys are extremely springy, but lack the travel of a full-size laptop keyboard.

While the dual-core Celeron Bay Trail-M processor doesn't quite have the same raw performance of the Intel Broadwell chip inside this year's — much more expensive — Google Chromebook Pixel, performance on the Dell Chromebook 11 is extremely smooth. In real-world use, it performance is similar to the Toshiba Chromebook 2. Both models share the same processor, RAM and screen resolution. With about 15 tabs running in three different browser windows there wasn't any slow down. It's generally fast, responsive, and exhibited no

delays. The Dell display isn't IPS, which is appearing on more Chromebook models, like the Toshiba, so it suffers from poorer viewing angles. It also offers an average 200-nit brightness that struggles in outdoor light. Audio, however, is very loud and clear enough.

In real-world use, with screen brightness set to 60%, the Chromebook 11 lasted for just over eight hours on a single charge under normal use, such as web browsing, emailing, editing documents and some YouTube viewing.

■ Chuong Nguyen

Verdict

Features
Performance
Value



Has features that are typically reserved for business laptops to create a product for the education market that excels.



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MSI Cubi

A fantastically small home theatre PC in a box.

If the MSI Wind Box was really just a tub of hot air, then the Cubi is a hurricane. A very good-looking hurricane. Sleek and small, with a clean design, our review sample is a treasure trove of golden hardware. It's everything the Wind Box should've been.

Around 1mm taller than Intel's NUC, the Cubi's slightly sloped, edgy physique gives it a much more arresting and elegant look. It's almost a shame that it's VESA-mountable and that most will be slapped onto the back of a TV, as the pristine, glossy-white chassis really does look quite at home on our desk.

Clearly, because of the size, it's not a powerhouse when it comes to performance. With a Cinebench score of 199 (almost double what its gusty cousin can produce), it loses out to the Intel NUC5i3RYK we tested recently, but only by 20 points. However, it

makes up for this by running silently. Idling at around 50°C and peaking at 70°C. Under load it's almost impossible to hear any noise without physically holding it to your ear.

The storage situation is also far better than its little brother. Our review sample came with 120GB of internal flash storage by default (107GB left over after a quick install of Windows 10). But with access to an additional 2.5-inch drive via an mSATA adaptor, the Cubi can accommodate up to 1TB of additional SSD space, if you require it. This does increase the height of the Cubi by a further 12mm or so, but all in all it's completely worth it for that expandability.

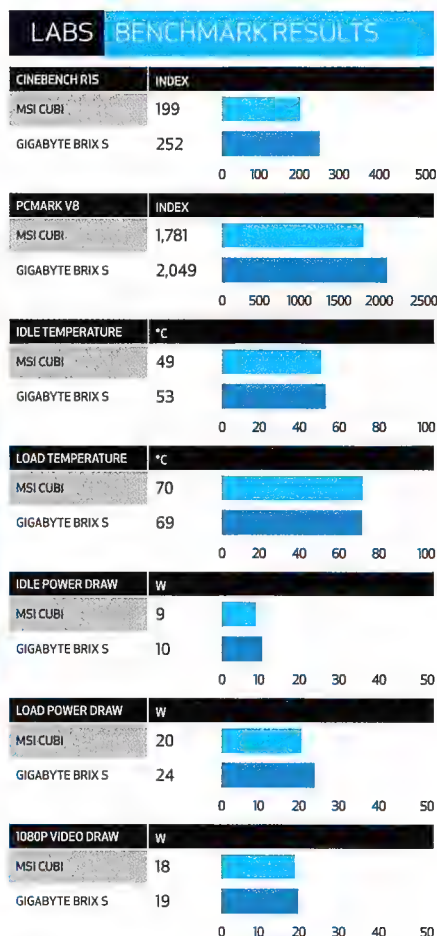
Speaking of expandability, it also includes two SoDIMM slots, allowing up to a total of 16GB of RAM. Couple that with a Broadwell Core i5 and you have yourself one seriously impressive work or home theatre PC, one that

you can fit into the palm of your hand, no less, and one that runs on an impressive 65W power supply.

IO is handled by a positive menagerie of connectivity, with the back featuring two USB 3.0 ports, Ethernet, Mini DisplayPort, HDMI and power. The front also boasts a four-pole input for headphone and microphone combos and an additional two USB 3.0 ports. It even comes with Wireless AC and Bluetooth 4.0, which is a must in today's modern age of high-speed gaming and streaming.

And did we mention this thing streams 4K? Because yep, although we guess that's not as impressive as we'd all like to think nowadays, there are still a lot of people out there using laptops that stutter playing 720p videos on YouTube. It's a PC rolling in at \$379 for the barebones Core i3 model, or \$499 for the Core i5 version.

The MSI Cubi comes in at a



very attractive price point and performs admirably in competition against the Intel NUC and its own little brother the Wind Box. For price to performance, you're not going to get any better any time soon.

All up, MSI seems well on the way to cracking the algorithm that will hopefully deliver the perfect, all-round Steam, office and home-streaming box. It's not 100% there yet, but it certainly looks promising for the future of micro-PCs.

■ Zak Storey

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Huge amount of expandability; relatively cheap alternative to Intel's NUC; looks gorgeous.





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LABS BENCHMARK RESULTS

Encoding performance

HANDBRAKE	VIDEO ENCODING - MINUTES (LOWER IS BETTER)
15-INCH RETINA MACBOOK PRO (MID 2015)	33
15-INCH RETINA MACBOOK PRO (EARLY 2014)	31
13-INCH RETINA MACBOOK PRO (MID 2015)	57

Gaming performance

BATMAN: ARKHAM CITY	RUNNING AT 1080P - AVG FPS
15-INCH RETINA MACBOOK PRO (MID 2015)	49
15-INCH RETINA MACBOOK PRO (EARLY 2014)	46
13-INCH RETINA MACBOOK PRO (MID 2015)	20

Battery life

BATTERY LIFE	WEB VIDEO STREAMING - MINUTES
15-INCH RETINA MACBOOK PRO (MID 2015)	377
15-INCH RETINA MACBOOK PRO (EARLY 2014)	318
13-INCH RETINA MACBOOK PRO (MID 2015)	405

MacBook Pro 15-inch with Retina display (Mid 2015)

Force Touch comes to the larger model.

We didn't have to wait too long for Apple's largest notebook to gain a Force Touch trackpad, and the 15-inch Retina MacBook Pro is now being offered in 2.2GHz and 2.5GHz models (there's a build-to-order 2.8GHz option, too). As you'd expect from the 'big' MacBook Pro, you get a stunning Retina display, which looks fantastic, and a Core i7 processor that delivers excellent performance when stacked up against the Retina 5K iMac.

Unlike the recently-released 13-inch MacBook Pro, there's no generational upgrade to the CPU. Here you get last year's 22nm Haswell processors rather than the even more power-efficient 14nm Broadwell of the 13-inch version (although that model is limited by having a dual-core i5 processor).

This is an odd decision in light of CPU developments, so maybe we'll see the 15-inch models leap straight to Intel's Skylake architecture – but that's likely to be at least a year away at best.

So, it's easy to be forgiven if you think this all sounds underwhelming and a little underdeveloped for something that should have moved on after almost a year. But it's by far, not the whole story by any means.

We looked at the 2.2GHz version only, so couldn't test the new AMD Radeon R9 M370X graphics, but we were very pleased when comparing its benchmark results against the 2.5GHz version from last year, which had a discrete graphics processor in the form of an Nvidia GeForce GT 750M with 2GB GDDR5 memory.

This new model's graphics benchmarks are

down on last year's 2.5GHz model, which you'd expect given its Intel Iris Pro GPU. For example, frames per second in Unigine Heaven 4.0 were down from 11 to 7.5, but in our Arkham City tests, the frame rate was slightly up from 46 to 49, yet down a fraction at 19 rather than 23 when running at the display's native resolution.

Elsewhere there are some clear wins. Blackmagic's Disk Speed Test brings to the fore Apple's claim that the flash storage in this new model is up to 2.5 times faster, delivering sequential read speeds of up to 2.0GBps (we recorded nearly 1.8). Write speeds were in the region of 1.2 times faster – still very pleasing.

CPU performance was also not far from last year's 2.5GHz model, only really losing out on single-core performance. As for battery life, we gained an

extra hour in our streaming test, which is not to be sniffed at.

All this adds up to a machine that's been slightly tweaked to eke out every last bit of performance from components that are looking a little aged.

■ Christian Hall

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

It seems like this MacBook hasn't really moved on, but tiny tweaks ensure it's still a great machine.





apc
HOT PRODUCT

MOTHERBOARD

\$549 | WWW.ASUS.COM/AU

ASUS X99 TUF Sabertooth

So sleek, so stealthy, so good.

ASUS is well known for its high-end componentry. Yes, it can come at a premium, but it's often money well spent if you're looking for feature-rich, reliable products. So, does TUF's latest X99 Sabertooth board hit that mark? Oh yes.

Since launch ASUS's TUF brand has focused on two things: reliability and consistency. And, although the RoG and Workstation series still exhibit these traits, it's hard to argue with TUF's reputation for being the workhorse of the breed.

This board looks spectacular, hiding the vast majority of the all-black PCB under the thermal armour. This gives the Sabertooth an incredibly clean look.

Internally, the board supports tri-SLI and Crossfire, thanks to three PCIe 3.0 lanes (for 16x16x8 or 16x8x4, depending on which monster you plug in to that 2011 socket). This gives

you enough graphical horsepower to not bat an eyelid when staring down the barrel at our eternal enemy – frame rate. For storage, there's support for M.2 PCIe. Additionally, there's access to one SATA Express connection alongside eight standard SATA 6Gbps ports. What's insane is the fact ASUS has managed to cram 11 fan headers across this board. But then that's something we've come to expect from ASUS. With offerings such as Fan Xpert II and the TUF ICE chip solution (allowing for an additional 5 PWM controlled fans), the X99 outstrips almost all of the competition for cooling capacity.

For rear I/O, there's four USB 2.0 ports, four USB 3.0 ports and two of ASMedia's new 3.1 ports, allowing for transfer rates of up to 10Gbps. Unfortunately, there's no mention of USB 3.1 Type C, something that would've been nice on such a

high-end board. Audio is handled with the standard 5.1 setup we've come to expect, with additional optical output, which is separated from the rest of the motherboard. It's supported by TUF's audio tinkering to make sure there's as little EMF interference as possible.

Core features include ASUS's current iteration of AI Suite and UEFI BIOS, with automated overclocking features for the more faint-hearted.

As for performance, we overclocked our 5820K to a respectable 4.4GHz at 1.3v with relative ease, and achieved some strong benchmarks. The Sabertooth also comes with access to TUF Detective, a specialised USB port in the rear I/O, allowing you to hook up an Android device to monitor your mobo in real time, similar to the RoG Extreme Front Base. This Sabertooth is impressive. Its cooling

potential is second to none, and certified with a five-year warranty, it certainly pulls its weight. Aesthetically, it's a beauty and we can't wait to get it into a proper build. We'll admit that it isn't cheap, but then if you're buying into the extreme edition processors, you're going to be used to paying that premium for reliability (and potentially looks). If you're after a board that's a dab hand at gaming and overclocking, plus a dependable workstation, the Sabertooth is definitely worth your time. ■

Verdict

Features
Performance
Value



Feature-rich; thermal armour; sleek and sexy aesthetics; TUF Detective; huge cooling capacity.



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MONITOR

\$1,200 | WWW.VIEWSONIC.COM.AU

ViewSonic VP2780-4K

IPS plus 4K? Think bear. Think woods

One day, everything will be 4K. Well, until everything's 8K. Or 16K. Actually, there will be a point at which further pixels are pointless. Once you've matched the visual acuity of the human eye, well, that's the end game.

The new ViewSonic VP2780-4K enters the fray at a middling 27 inches. The upside is that it looks super-sharp. If you thought a 27-inch panel at 1440p looked crisp, 4K on the same panel size will absolutely blow your mind. And yet, not without pitfalls.

For starters, everything is tiny with Windows running at its default settings. So tweaking the DPI setting to make everything a bit bigger is likely essential. But that throws up its own problems.

Then there are all the third-party apps and software that haven't been optimised for multiple DPI settings. And, of course, most of the internet.

People tend to forget about the latter, but very few web

sites are properly coded for multiple DPIs. It doesn't matter so much on a small portable screen. But on a big PC monitor, those stretched bitmaps and jpegs can clash with the super-crisp fonts.

Put it all together and we still think 4K makes most sense on panels well over 30 inches, where running default DPI settings can be done with reasonable comfort. The other generic 4K conundrum involves gaming, or more specifically the problem of pumping all those pixels to the panel in a timely fashion. Essentially, 4K involves a scarcely comprehensible eight million pixels, all of which have to be pushed through the graphics pipeline with all the advanced 3D processing that now entails.

Anyway, 4K gaming is possible, but only just. And that's when using a high-end graphics card or cards. As it happens, thanks to that tight pixel pitch, interpolated resolutions like 1440p look pretty good on the ViewSonic. In theory, you

could make do with 1440p until truly 4K-capable graphics cards become affordable. That's your call.

You'll also have to decide whether features like high refresh rates of 120Hz and more, or adaptive-refresh technology are deal breakers, because inevitably, the 4K panel doesn't have them. Even on the desktop, 60Hz screens suffer from noticeable judder compared to the high-refresh brigade.

So, thanks to the recent explosion in monitor innovation, finding a model that packs all the features you want is tricky, going on impossible. Want 4K, plus 120Hz, plus frame syncing? Yes please. But it simply isn't available, never mind that the notion of pumping eight million 3D-rendered pixels at 120Hz seems quite preposterous right now.

Still, if the 4K aspect of the VP2780-4K is problematic, specifically at 27-inches, in a broader sense, we've little quarrel with the panel's quality. It's IPS and when you fire it up for the first time, it

looks absolutely, positively spectacular at factory defaults. That's no doubt aided by a proper pre-delivery calibration.

It's so rich and vibrant while also being natural and not over-saturated. It's a tricky balance to strike and this ViewSonic absolutely nails it. For the record, it demolishes our objective image tests, turning in perfect white and black scales, immaculate gradients and super viewing angles.

If you're after a 27-inch IPS 4K screen running at 60Hz, this is mega. But unless you're a graphics or imaging pro, we're just not sure you need it. ■ Jeremy Laird

Verdict

Features
Performance
Value



Stunning IPS-plus-4K image quality; all those pixels; nice chassis and stand.





The router can serve as both VPN server and client.



The Content Security Management uses signature-based filters to block user access to major business time wasters as well as P2P.



BROADBAND ROUTER

\$460 | WWW.DRAYTEK.COM.AU

DrayTek Vigor2860ac

An affordable and secure small business router.



DrayTek's new Vigor2860ac is something of a jack of all trades. It's a VPN-capable security router nominally targeted at (and priced for) small business, but it also includes a number of features that might appeal to technical home users too.

Let's start with the hardware: it's a router with a DSL modem built in as well as an Ethernet WAN port; there's a six-port gigabit LAN switch and triple-antenna 802.11ac wireless support up to 1300Mbps. The combination of DSL modem and WAN port is potent, giving you options for future connectivity – and the DSL port supports both our current ADSL standard as well as VDSL2, which is one of the many possible avenues that our new Multi-Technology Mix NBN network may go down (fibre to the node installations will likely use VDSL, for example). The two USB 2.0 ports on the router can also support a 3G/4G modem for

additional connectivity; they support storage as well, with file sharing via SMB or FTP (but no DLNA media sharing). But it's more than just the generous port allocation that sets this apart from a typical consumer level router. The firmware is packed with business-ready features: virtual LAN segmentation, multiple SSIDs, advanced user controls, connection load balancing and routing rules (if you have, for instance, both WAN ports connected to different networks), centralised support for up to 20 wireless access points, sophisticated signature-based content and application filters, centralised VPN management and more. We particularly liked the ease with which we could add access points to the managed network – it made setting up a distributed wireless network that much easier. The VPN support is capable. It can act as both a server and LAN to LAN client, with up to 32 tunnels connected at once. Its support for PPTP

and IPSec is solid, but the same can't be said for its support for OpenVPN/SSL. Sure, it supports SSL VPNs, but it's clearly a tacked on feature and disabled by default. Indeed, switching it on prompted the router to give us a warning that it's insecure! As you might expect from a security router, the user interface isn't as user-friendly as a full consumer router. In fact, there's no hand holding at all, so if you don't know what a VLAN is, or load balancing, and all that stuff about VPN support sounds like gibberish, this probably (definitely) isn't the router for you. The performance, we were pleased to see, was very solid. We tested the wireless copy performance using a Linksys WUMC710 client bridge, and found the copy speeds more than acceptable. At 15m, through two plaster walls, it had an average throughput of 29.8MB/s. For comparison, in the same environment, a Netgear D6300 hit 27.7MB/s. Ultimately, the DrayTek

Vigor2860ac is a very capable small business security router. It has far more sophisticated business features than you'd normally expect at its price, and it has capabilities that actually might appeal to some consumers, including an integrated modem. There's even a slightly different model of the router – the Vigor2860Vac – that has integrated VoIP with PSTN failover. It does have shortcomings like its limited SSL and USB support, but if you're prepared to face a very technical interface and play around with it, there's an awful lot under the hood here. ■ Nathan Taylor

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

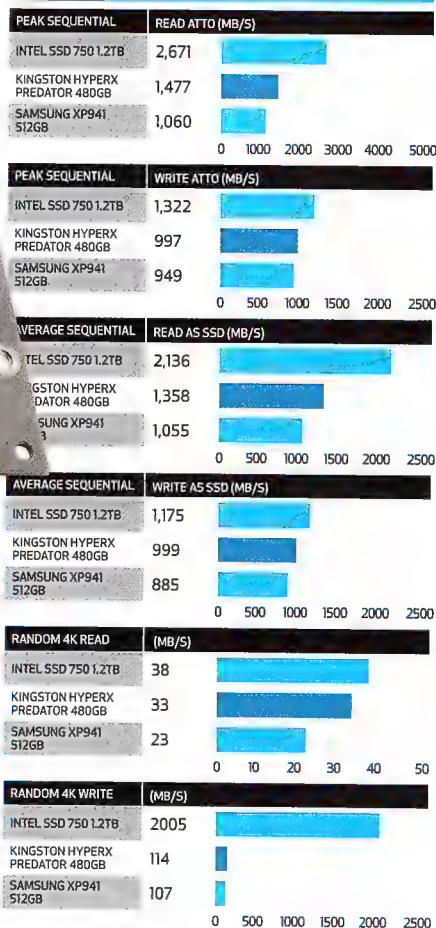
An affordable security modem router, including features you'd be hard pressed to find elsewhere at this price.





PCIE SSD \$649 | WWW.KINGSTON.COM

LABS BENCHMARK RESULTS



Kingston HyperX Predator 480GB

Super-fast SSD you can actually afford..

Once the SATA bandwidth limit of 6Gbps was reached, the hunt began for an interface that would allow the continued advancement of high-performance SSDs. And once it was decided that using the motherboard's PCI Express lanes was the way to go, the world sat back and waited for the expected deluge of drives. Well, the world still waits. The deluge simply never happened.

The latest PCIe-based drive to hit the labs bench is from Kingston, which has quite cleverly covered both format options with the new HyperX Predator. It's available as a plain M.2 2280 drive that fits in a motherboard M.2 (PCIe) socket. It can also be housed in a half-height, half-length daughter card, which slots into a standard PCIe Gen 2.0 x16 slot for anyone with a motherboard lacking an integrated M.2 socket.

The Predator is Kingston's first foray into high-performance M.2 drives and is available in 480GB and 240GB capacities, with a 960GB capacity drive rumoured to be appearing later in 2015. At its heart lies the latest Marvell 88SS9293 PCIe 2.0 x4 controller, which looks after the Toshiba A19 Toggle 19nm MLC NAND. The 480GB drive uses eight 64GB packages (four per side of the PCB) to get its 480GB capacity. Well, to be totally accurate, its 512GB capacity — the spare 32GB is used for over-provisioning. There's also a couple of Kingston's own DDR3 1,600 512MB chips on each side of the PCB for 1GB of cache.

Even though the HyperX Predator uses the old ACHI architecture, rather than the latest NVMe design, and has a PCIe x4 Gen 2.0 interface, and not the much faster Gen 3.0, its performance still leaves all SATA-based drives floundering in its wake.

One commonly asked question when it comes to these new M.2/PCIe drives is whether they're bootable. Well, thanks to its on-board OROM, the answer for the Predator is a resounding yes, and on a wide range of motherboards, which will broaden its appeal.

Quoted sequential read and write performance for the 480GB drive is 1,400MB/s and 1,000MB/s, respectively, while for the 240GB model its 1,400MB/s reads and 600MB/s writes. A quick blast of the ATTO benchmark produced figures of 1,477MB/s for reads and 949MB/s for writes, a little lower but still pretty stunning. The more demanding AS SSD benchmark produced a lower read figure of 1.3GB/s, but a better write figure of 1GB/s.

When it comes to 4K random reads, the 33MB/s isn't going to set the world on fire, but 114MB/s for random writes is excellent for an

ACHI drive. The drive is no slacker in real-world testing either, taking just over two minutes to copy a 30GB Steam folder, the transfer rate peaking at around the 530MB/s mark.

Endurance figures for both drives is impressive. The TBW for the 240GB is 415TB, while the 480GB drive comes in with 882TB. In these days of 5- and 10-year warranties for high performance drives similar to the Predator, however, Kingston's three-year guarantee feels stingy.

■ Simon Crisp

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

A PCIe drive for the consumer market; form factor options; fast and easy to set as a boot drive.



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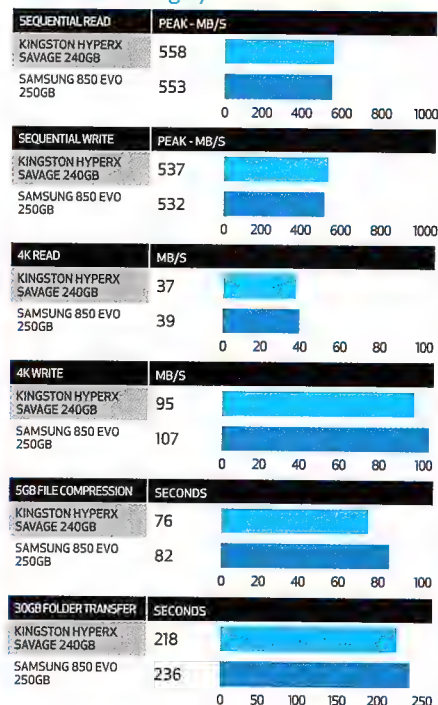


SSD

\$159 | WWW.KINGSTON.COM

LABS BENCHMARK RESULTS

Performance Category



Kingston HyperX Savage 240GB

Performance soothes the savage beast

Compared to some of the SSDs we've seen from Kingston, we'll accept this latest drive has some call to use the HyperX nomenclature. It's actually impressively speedy, and not just when compared to some of its more pedestrian stablemates. Put up against Samsung's 850 EVO, resplendent with its 3D memory and in-house MGX memory controller, this Kingston effort manages to keep pace and, in some instances, actually outperform it.

We've got to say, the thing which really gives this latest HyperX the performance Kingston has been craving is that eight-channel Phison PS3110-S10 memory controller. The last HyperX SSD we tested was still using the aging SandForce controller, making it an effective irrelevance — especially when the likes of Crucial and its half-terabyte MX100 drives were making fools of almost the entire industry.

It's not the first Kingston drive to pack a Phison controller. The SSDNow 310 we tested a while back was rocking an older version. It was a version that definitely wasn't going to set the storage world alight, but in the relatively affordable high-capacity end of the SSD market, it kinda made sense. Speed in that sector is less important than capacious data stores.

For the HyperX brand, though, pace is paramount. And here the current Phison controller, coupled with the 19nm Toshiba MLC NAND, delivers performance that almost puts it ahead of even the 512GB Samsung 850 Pro. Compared with the similarly priced 250GB 850 EVO, this Kingston takes the plaudits in terms of the peak and average sequential benchmarks.

It's a little behind on the random 4K read/write speeds, but not by much. It's certainly up there with the main contenders in the SATA 6Gbps world. But yes, we're still talking SATA. NVMe

drives remain rarer than a non-cynical tech journalist — both the Samsung 850 drives and this latest Kingston are bumping their heads against the limits of the interface. Much as SSDs have been doing since the SATA 6Gbps interface met NAND flash.

Where the Kingston drive does show improvement over the competing Samsung drive is in the real-world file compression and data transfer tests. It's almost 20 seconds quicker on our hefty 30GB Steam folder transfer.

But it's still slower than the larger 500GB Samsung, with its greater parallel performance, though we don't know whether the eight-channel Phison controller will deliver the standard speed hike that now comes with higher capacity. We'll need to get our hands on its big brother to figure that out.

What we can say is that the latest HyperX SSD finally offers genuinely competitive storage performance, and in a world hobbled by the SATA

interface, that's pretty much all you can ask for. A drop in price would be nice, but it's not exactly expensive.

But would we recommend the Kingston over the Samsung? Probably not. Performance is there in spades, but the consistency tests show it's a little more prone to performance spikes than the 850 EVO when really being pushed. And then there's the warranty. There's still the longevity fear with solid state, and having the five-year, as opposed to three-year, warranty definitely inspires confidence. But it sure is close. ■ Dave James

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Speedy Phison controller; good value; impressive real-world performance.





GAMING STEERING WHEEL

\$219 | WWW.THRUSTMASTER.COM

Thrustmaster Leather 28 GT Wheel Add-On

Hand-stitched leather hasn't looked this good since *Desperate Housewives*.

While the sight of a fake steering wheel clamped in front of your monitor could be seduction suicide, fear not, as this wheel may as well be an aphrodisiac, exuding quality from its hand-stitched leather and 2mm-thick brushed-metal center panel.

Six buttons and a D-pad provide plenty of control, plus there's a manettino dial for a taster of what life would be like behind the wheel of a Ferrari 458. Thrustmaster's dial is more show than go though, with an air of a budget 1990s stereo, rather than Maranello's finest.

Otherwise, you'll be hard-pressed to find any quality flaws. Despite weighing just 1kg, the wheel is fitted with substantial 13cm-long metal paddle shifters, so there's no excuse for missing a gear shift for a fast getaway. The buttons

are rated to withstand over 10 million hits, and the 28cm-diameter wheel gets an inner steel hoop for strength and better force feedback transmission.

Trouble is, you can't just fling this wheel about in mid-air and expect things to happen. You'll need a T300, T500, or TX-series racing system to use it, and since these already include a wheel, your bank balance isn't going to be happy, with compatible setups starting at around \$300.

At least you'll be able to attach and remove your leather-bound beauty in no time, courtesy of Thrustmaster's Quick Release system, right? Well, rather than a simple locking clip mechanism, such as you might find attaching an F1 car's steering wheel, here you'll need to tighten a large plastic nut instead. No big deal, if only the nut didn't nestle in the annoyingly

tight gap between the back of the wheel and the motor unit.

But once everything is ready and you can put pedal to metal (well, plastic), it all comes good. Whichever racing system you mount the Leather 28 GT to, TM's excellent force feedback motor brings it to life. There's a colossal 1,080-degree max rotation, plus dual belt drive for near-silent force feedback, and contactless magnetic position sensing for max rotation accuracy and increased longevity. The result is superbly strong and communicative feedback, with none of the usual gear grinding that lesser wheels can produce.

Such advanced internals do need to be kept cool by means of a fan, and unfortunately this is far from silent. It's certainly not going to overshadow your racing, but it's loud enough to partly undo some of the effort that went into making

the motor drive so smooth and quiet.

Of course, the TM Leather 28 GT isn't to blame there, but it's not off the hook. This is undoubtedly a great wheel, but it's also essentially the same as what's included with Thrustmaster's T300 Ferrari GTE setup, only you get to grip leather rather than rubber. If you could spec your own motor/wheel/pedal combo, then it'd make sense, but splashing this much cash to get a second wheel purely for a different texture is a little overkill.

■ Ben Andrews

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Top quality materials and build; plenty of controls; multi-system compatibility.





SMARTPHONE
FROM \$999 (32GB) | WWW.SAMSUNG.COM

Samsung Galaxy S6

The new Android standard.

Known by many as the flagship Android phone, the latest handset in Samsung's Galaxy S series needed to come out of the gate swinging in order to keep the well-received iPhone 6 at bay.

Enter the Samsung Galaxy S6 – an incredibly powerful smartphone with an improved build quality, a magnificent display and a great camera. Finally ditching the uninspired plastic body seen in previous models for a metal frame with a glass backing (albeit with iPhone 6-style plastic strips, to ensure the antennas and radios work correctly), the Samsung Galaxy S6 instantly feels like a premium device. While the phone's design may have taken the iPhone challenge all too literally (our white model looks remarkably like a white iPhone 6 at first glance), the rest of the phone is pure Samsung. Its stunning 5.1-inch Super AMOLED display takes the crown for

sharpest screen on the market, with a 1,440 x 2,560 pixel count that matches previous title-holder, the Galaxy Note 4, but improves on it with its PPI count (577). In terms of performance, the Galaxy S6 is a monster, only slightly outperformed in our benchmarks tests by its flashier cousin, the S6 Edge. It's backed by a whopping 3GB of RAM and an Exynos 7420 processor that packs four 1.5GHz and four 2.1GHz cores, making it the fastest Android phone currently available. If there's one major drawback, it's battery life – the Samsung Galaxy S6 lasted just under 7 hours in most of our drain tests, making it one of the least energy efficient handsets around.

■ Stephen Lambrechts

Verdict

Despite its sub-par battery life, the Galaxy S6 is the best Android phone to date.



SMARTPHONE
FROM \$1,149 (32GB) | WWW.SAMSUNG.COM

Samsung Galaxy S6 Edge

It's edgier, but is it better?

While the standard Samsung Galaxy S6 could be accused of aping the design of Apple's iPhone 6, its edgier alternate version, the Samsung Galaxy S6 Edge, is entirely unique.

Think of the S6 Edge as the greaser kid in a 1950s movie who rocks up to school wearing a leather jacket and carrying a switchblade – it's flashy and full of style, but it gets hot easily and, if you're not careful, it feels like it could cut you. (Yes, that's a slight dig at its sharper metal frame, which makes the S6 Edge less comfortable to hold than the standard Galaxy S6.) Internally, the S6 Edge is practically the same as the regular S6, though its battery is 2% bigger thanks to its relocated SIM-tray. The phone's curved tempered glass makes it look thinner than the standard option, but it's actually 0.2mm thicker. It's also 6g lighter,

due to having less metal on its body. The curved screen provides some additional features, though none of them are anything to write home about. Time can be displayed while the phone's asleep, and you can flick 'People Edge' mode out from the right side of the screen to reveal up to five designated contacts (though this feature could've easily been included on the standard S6). You can also see the edges of the screen glow in colours assigned to specific contacts while the phone is facing down. Still, none of this stuff really justifies a 15% price hike in our eyes, so you're going to have to really love the design to be willing to cough up the extra cash.

■ Stephen Lambrechts

Verdict

Aesthetically unique, but we're not sure the design is worth the higher cost.





COLOUR SENSOR

US\$349 | NIXSENSOR.COM

Nix Pro Colour Sensor

Discover the precise colour of real-life things. Sort of.

If you wanted to figure out what colour a pixel in an image is, you could use the eyedropper tool in Photoshop to grab its recipe. But if you wanted to figure out what precise colour something is in real life, you had no such luxury. Until now. Ish. In theory.

This peculiar, enigmatic, vaguely diamond-shaped device, about the size of a disappointingly small cupcake, connects wirelessly to an iPhone and when you press it against a colour, it reads it and sends it to your device — defining its RGB, CMYK, hex and CIE Lab values. You can save it, compare or share it by email or on social media. So far as it goes, it seems to work, even if the app feels a bit unfinished. We agree with Nix that in part because the sensor is enclosed you get far more accurate results than if you used a standalone smartphone app which relies on its camera, even if the design of the Nix means the colour you're scanning has to

be on a flat surface. We worry about accuracy, though — not having any objective way to measure or calibrate its results — and thus we have some concerns about who this is for. It's easy to assume it's for creative pros, but it can't be calibrated into a colour workflow and isn't integrated into a system such as Pantone. The concerns over pro-level accuracy might be fine in a product costing \$100, say — something for hobbyists to have fun with — but this is almost four times that. A previous version converted sampled colours to paint swatches, which could be handy, but that's missing from the current version. ■ Christopher Phin

Verdict

Promising, but expensive — it's not calibrated to a trusted system, and we can't easily test accuracy.



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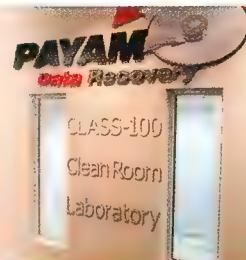
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Windows SOFTWARE

FileMaker Pro 14

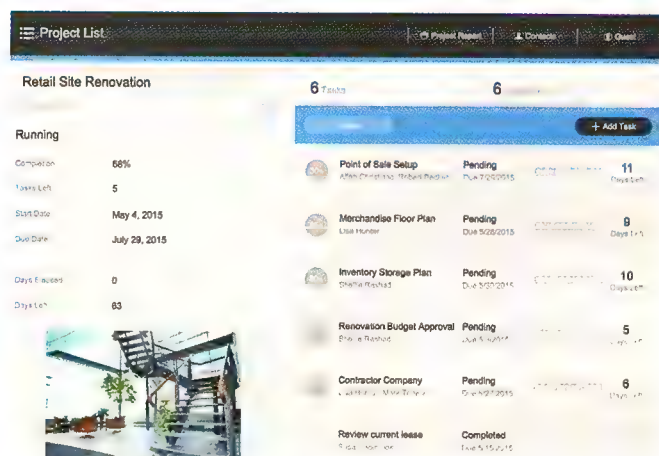
The stalwart database software gets a youthful revamp.

\$329 (\$196 UPGRADE) | FILEMAKER.COM



Believe it or not, Apple subsidiary FileMaker turns 30 this year, and the latest version of the venerable productivity solution proves that, like wine, some things only get better with age.

FileMaker Pro 14 continues a recent trend of updated interfaces following the introduction of Launch Center, which streamlines the appearance of favourite or recently-opened files. Solutions can now be assigned one of 29 colourful icons, or have custom graphics applied. The approach has been implemented across the FileMaker universe for a consistent look and feel on Mac, Windows, iOS, or web browsers. Likewise, the Starter Solutions feature introduced with version 12 has been redesigned, with 16 layouts that also work on WebDirect and mobile. This makes it far easier for novice users to get up to speed with ready-made templates for contact, invoice, inventory, project, or event management databases. WebDirect (FileMaker's tech for running Solutions directly in your web browser) has also gone mobile in this version, allowing tablets to run desktop solutions on Safari for iPad, or Chrome for Android. (Chrome for iOS isn't recommended, and didn't work so great in our tests.) We found the print options to be less robust, there are a few limitations involving container fields, and many dialog boxes haven't yet been touch-optimised, but the experience was otherwise



quite smooth. WebDirect is also now up to 25% faster at running many web-optimised layouts and you'll feel the difference; an overhauled toolbar offers finger-friendly tap targets for mobile devices, and menus that slide in or out and automatically collapse or expand when the device is rotated. Other interface improvements include a new button bar, button icons, and in-field labels, along with a colour palette coordinated with the selected theme.

Switching to mobile is more seamless, thanks to a new look for the free FileMaker Go 14 iOS app and the ability to launch solutions in fullscreen mode. There's also more control over video or audio playback (which can now be done from container fields). This is a significant refresh for the veteran software that unifies the experience across desktop and mobile.

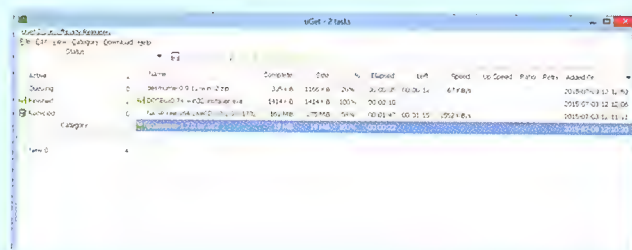
J.R. Bookwalter



uGet 2.0

FREE | UGETDM.COM

uGet is a cross-platform and open source download manager available on both Windows and Linux. This isn't a dedicated BitTorrent client — just one for straight web downloads — and it has a whole host of distinguishing features. (While BitTorrent is a standalone technology combining tech and social/sharing elements, a regular download manager is a less social beast and more technical.) Before the peer-to-peer era of downloads — when broadband internet connections were in their infancy — download managers were extremely relevant for everyone who needed to control data usage and special timeframes with lower data rates. Today those issues are still relevant for those that have to use a mobile broadband paid subscription, or just want to make sure that they can resume their downloads if they happen to break halfway through. If you frequently need to download a lot of massive files, your standard web browser isn't the best solution, but a standalone app can do the job better. uGet is a lightweight, open-source download manager with advanced features. It can put files in a download queue, pause and resume downloads and has advanced category



management. uGet also has FireFox Integration via a FlashGot extension, clipboard monitoring (it looks for URLs there) and batch downloads. The client supports a host of protocols too, including HTTP, HTTPS, FTP, BitTorrent and Metalink. It can also be controlled remotely using the command line or work without notifications in Quiet Mode and use Proxy credentials and limit the number of connections and more. Downloads can be organised into categories, which are helpful for filtering items when you feel you have too many of them. It's a good download manager for those who need an advanced and mature application — whether you're running Windows or Linux.

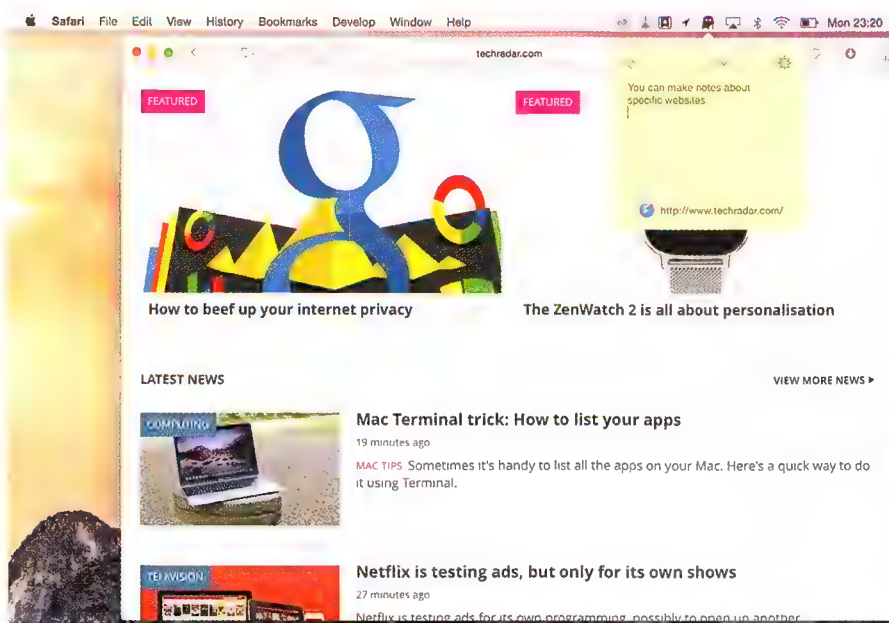
Alexander Tolstoy



Ghostnote

Make notes on anything and keep them discreetly tucked away.

\$12.99 | WWW.GHOSTNOTEAPP.COM



Ghostnote is a Post-it-style app with a difference. Instead of littering your Desktop with notes, it's made them context-aware. You can apply them to a document, folder or dozens of supported apps.

When running its icon sits in your menu bar. Click on it while in an app or with a folder or document selected and an empty note drops down. Text in notes can be formatted, including making it an ordered list or bullet points. And you can add tasks with tick boxes next to them. Note colours can be customised and detached from the menu bar so they float on the desktop. In some apps, you can add notes to individual documents and, in Safari, to specific web sites. It's not always the most intuitive app, however. By default the feature that allows you to add notes to documents and folders isn't active. If you click on a file or folder in Finder, you'll only be able to add a note to Finder as a whole. To add support, you must click on the Ghostnote menu bar item, click the gear wheel and choose Install Document Support. On the plus side, the use of icons at the bottom of notes means you're never in any doubt about what each note is attached to.

Kenny Hemphill



CleanMyMac 3

\$39.95
WWW.MACPAW.COM

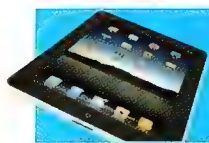
The third iteration of MacPaw's Mac cleaner is here and includes several much-needed improvements and features. There's a new menu bar icon to offer convenient access to the main program, as well as a quick summary of drive space, memory and Trash. The main interface also gains an optional dashboard view with a detailed breakdown of key stats. The program includes six cleaning tools and five utilities — four of which are new to version 3 (Mail Attachments, iTunes Junk, Maintenance and Privacy). There's little ground-breaking here, although we like the new Maintenance tool's promise to fix application errors and optimise your disk and search index. One criticism of past versions is the fact it's too easy to scan and clean up with the two-click Smart Cleanup module. It's a risky approach that may result in you accidentally deleting a critical file or



setting. While CleanMyMac 3 does a better job of providing explanatory notes for each cleaning tool, it still doesn't make it mandatory that you review what it's found before going further. This is especially important considering no fail-safe mechanisms are provided. CleanMyMac 3 is

a slick, fast app that will clean your Mac. But the lack of an undo tool or backup protection makes it hard to recommend to the very people it's targeted at: less experienced users who want a simple, quick and safe cleanup tool.

Nick Peers



App Store » iOS APPS

Hyperlapse from Instagram

Instagram's iOS-exclusive time lapse app

FREE | TINYURL.COM/O4CRGPZ



Want to make effort-free time lapse videos? Well you can put your GoPro away – Instagram's free app Hyperlapse has an interface simple enough for anybody to create smooth and speedy videos with a few taps of a screen.

Hyperlapse presents the user with a full video screen and two buttons – a smaller one to switch to the front camera (dubbed Selfielapse) and a bigger button to start and stop recording. Once you've finished, simply choose the speed you want the video to run at (from 1x up to 12x). When you're ready, share your Hyperlapse video to Facebook, Instagram and more.

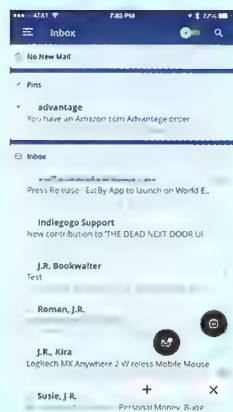
Stephen Lambrechts

Air Display 3

\$14.99 | WWW.AVATRON.COM



Air Display 3 and its free Mac-based host turn your iOS devices into additional screens, expanding your workspace. Installation on the Mac requires a reboot, but connection is simple. Attached displays can be zoomed and rotated; we found the latter switched the setup to mirror mode, but this was easily fixed. Usefully, Air Display 3 has Retina and HiDPI options. The former usually makes for small, fiddly interfaces, but the latter provides a pin-sharp second display. On Wi-Fi, responsiveness is poor; menus half-fade and stay put, and graphics "tearing" is commonplace. Therefore, to use the second screen for anything beyond housing static reference, connect via USB. Avatron claims this leads to "no perceptible lag," though we saw plenty of it in our tests, but the responsiveness was much improved. Unfortunately, the custom iOS keyboard "pushes" the screen upwards when activated — it'd be better as an overlay. (The screen behind can be moved with a two-finger drag.) This latest release also adds Air Stylus, which can turn your iPad into a kind of graphics tablet so you can draw with a stylus directly into compatible software in mirrored mode. Pressure sensitivity is supported, a boon for artists, but we'd still prefer dedicated kit in a studio set-up. A decent upgrade and worthy of consideration to get more use out of dormant iPads, even if lag remains an issue. Craig Grannell



Spark

FREE | READDLE.COM



The only third-party email app thus far to really make us sit up and take notice.

Featuring a comparable unified inbox approach, Spark emphasizes smarter email, rather than trying to reinvent the wheel. One unique feature we like automatically sorts incoming missives into personal, notification, or newsletter categories, stacking them atop a Smart Inbox view until read, at which point they fall back

in line with the rest of the inbox. Important messages can also be pinned (Spark's version of flagging) at top to keep them front and center. The natural-language-based smart search works well, but Spark's "smart" notification system isn't quite as intelligent — at least not initially. There are other features Spark absolutely nails: it's one of the most customisable email clients, allowing users to tweak which "message cards" show up in its sidebar and handy pop-up widget — for example, results from saved smart searches, specific IMAP folders, or a basic calendar view. It's pretty solid for a 1.0 release, scoring bonus points for its ability to save emails as a PDF file, send or save attachments to a variety of cloud services like iCloud, Dropbox, or Evernote, and full voice dictation for longer replies. Spark hasn't kicked Apple Mail off our dock quite yet, but it's already neck and neck with Microsoft Outlook as one the best third-party email apps around. J.R. BOOKWALTER



ectron

SILENCE MEETS PERFORMANCE



NEPTON 240M

FAN NOISE : <27dBA PUMP NOISE : <15dBA

- Custom Water Block
- 5X Skive Fin Area, 120L / h water flow



JETFLO

FAN NOISE : 19dBA

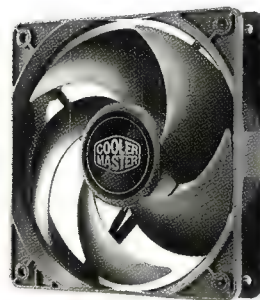
- High Air Flow for quick hot air exhaust
- 95CFM Max.
- Smart Fan Engine
- POM bearing (160000 hours life span)



SILENCIO FP

FAN NOISE : <14dBA

- High Air Pressure to push air through HDD Zone
- Smart Fan Engine
- LDB bearing (160000 hours life span, IP6X Dust Proof)



V SERIES PSU

- 80Plus Gold
- 100% Japanese Capacitor
- Powerful +12V rail output



coolermaster.com

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PCCG - www.pccasegear.com



Google Play » ANDROID

Google Photos

The best photo backup app, with unlimited storage for images and videos.

FREE | TINYURL.COM/OXCPVL5



It's Google to the rescue once again, with another fantastic (and free) cloud-based service that gives users unlimited backup storage for their entire photo collection, so long as they don't mind reducing the quality of their images a little.

If you don't like the sound of that, Google Photos offers 15GB of full resolution image storage, which sounds quite a lot smaller than 'unlimited', but is actually three times as much as Apple offers on its iCloud service.

Best of all, it'll also auto-tag and organise your library, saving you a mountain of time in the process. It also works across all of your devices, uploading your pictures from each one so you'll always have your memories on hand. Admittedly, Google Photos' backup process can take a fair while, so it's a good idea to start it up and put it aside while it does its thing. Google Photos is a great option if you never want to worry about losing your precious pictures again.

Stephen Lambrechts

Saturday, 20 Sep 2014



Friday, 19 Sep 2014



Unclouded

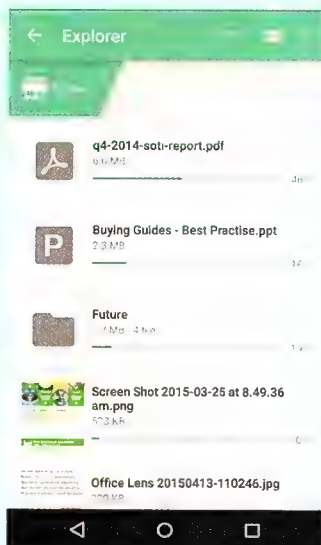
FREE WITH IAP | TINYURL.COM/APC418-UCLLOUD



Whether it's using Dropbox to backup

your Android's photos or checking a work document through Google Drive, for many of us, cloud storage has become an integral aspect of using our smartphones. But cloud storage space is limited and if you're jumping between multiple services, keeping an eye of how and where you're storing your documents, photos and videos can become a real chore. Unclouded aims to be a central hub for all your cloud accounts, giving you a single spot where you can manage your data and ensure you're not unnecessarily doubling up on anything, even when you're offline. It has a simple graphical layout that will display pooled information from all your cloud services and an intuitive menu to look more specifically at individual services or the distribution of specific file types. There's also the option to pay for additional features (like a security pin and different themes) but the free version of Unclouded offers all you really need to keep your clouds from turning dark and foreboding.

Joel Burgess



Android Device Manager

FREE | GOOGLE.COM/AU/ANDROID/DEVICEMANAGER

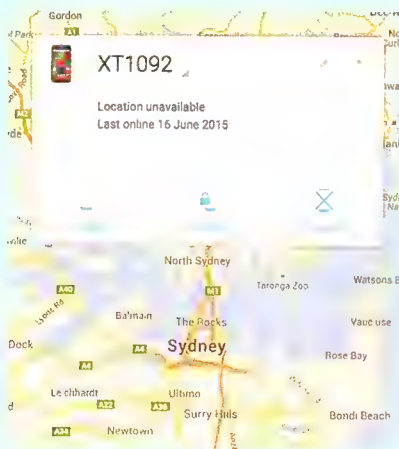


If you're as reliant on your smartphone as we are, losing it is a big deal. There are a few apps that help safeguard against losing your Android (Cerberus, for example — cerberusapp.com),

but Android Device Manager offers the most simple way of doing it — not to mention the fact that it's made by Google. Just download the app, log into your Google account and make sure your Android's location settings are turned on. Then, whenever you need to, you can use the web interface to see where your device is, set it to ring, lock it using a new password and even display a contact number on its screen. The remote ring volume will be as loud as your device can muster, even if the smartphone was set on mute and the browser-accessed device locator should generally get you

close enough to hear it ringing. As a last resort, you can also wipe your Android so thieves can't get at your data — a pretty powerful option for something you can set up in under a minute.

Joel Burgess





Windows Store » WIN PHONE 8

WhatsApp

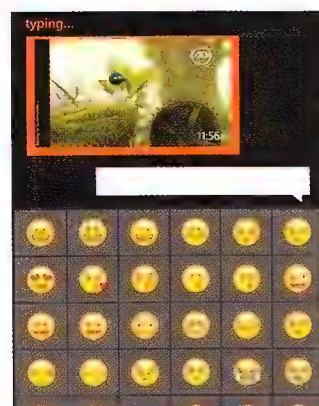
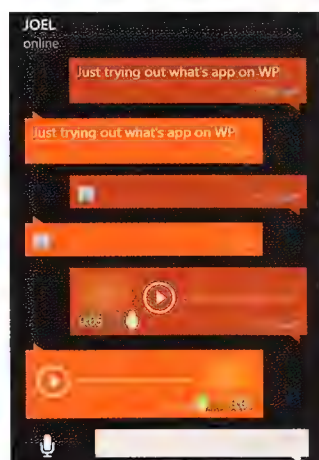
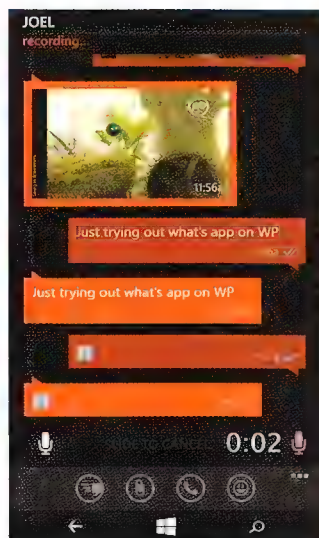
The modern MSN Messenger can now talk.

US\$1 A YEAR (FIRST YEAR FREE) | WHATSAPP.COM



This popular instant messenger app was purchased by Facebook early last year for a tidy US\$16B and promised to start rolling out voice calling features soon after, across all compatible platforms. By March 2015, the company had ticked off voice calling compatibility for a broad list of Android devices, with iOS updates following soon after.

And now Windows Phone users can finally enjoy the fruits of WhatsApp's web calling update too. Considering one of the best aspects of this web messenger is the group messaging function and that the call features only allow for one-on-one conversations, the new update also brings with it the added ability to send recorded audio messages to your group. WhatsApp already offered a raft of unique features that let you send custom automated responses ("Can't talk my phone is about to die", for example) or your GPS location on an interactive map, so even though it costs US\$1 per annum (after the first free year) the new audio features are a welcome icing on an already desirable app-cake. **Joel Burgess**

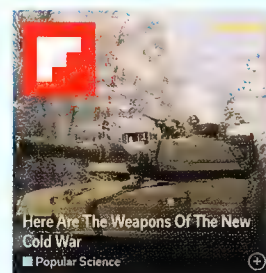


Flipboard

FREE | FLIPBOARD.COM



Flipboard is a modern-day personalised social media magazine that plugs into all your social accounts and presents the most-relevant news in a slightly more visually-appealing way than your average RSS reader. On top of allowing you to plug into your social streams you can follow individuals on Flipboard (much like on Twitter) and feed web sites into a news reel. From here you can share, like, comment on or clip articles and add them to a curated magazine that you can read later. It's picture-heavy layout makes it great across its extensive range of compatible devices, but due to its beautiful design we definitely prefer it on the bigger tablet screens. There's no doubt that Flipboard is borrowing from a number of app styles (say, Evernote, Reader and Twitter for example) and generally having such a sprawling lack of focus results in a slightly confusing application. But Flipboard seems to juggle these influences and produces something useful overall, even if that 'something' is slightly harder to explain than your average app. **Joel Burgess**



Warriors Win NBA Title: Pictures
The Photo Desk in The Photo Desk

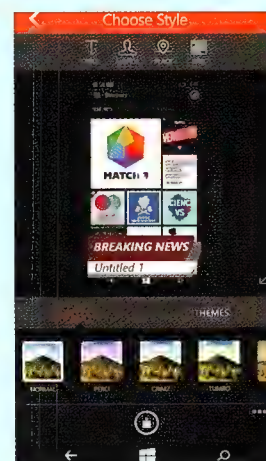
What is Snapchat? CEO Evan Spiegel explains it all for parents
The Guardian

Videoshop

FREE | VIDEOSHOP.NET



With editing apps for smartphones, there's a delicate compromise struck between the number of editing features and the simplicity of the app overall. Too much either way and you end up with something completely useless or, conversely, overly time consuming. In terms of features, Videoshop really pushes the envelope. The app includes enough ways to edit your imported or in-app videos to genuinely justify a \$2.49 price tag for the iOS version. What's better is that it's currently available on Windows Phone for free, and the devs have managed to make this full-featured version so intuitive that you can easily prod your way through a sophisticated level of video editing effects. Videoshop lets you overlay text, verbal narration and music, as well as trim clips and add transitions between them, resize and rotate footage, apply filters and manually tweak colours — you can even add banners that slide into frame like a news report. The fact that you can do all this with drag and drop elements and then save or upload straight to YouTube makes it an appealing app for anyone interested in video creation. **Joel Burgess**

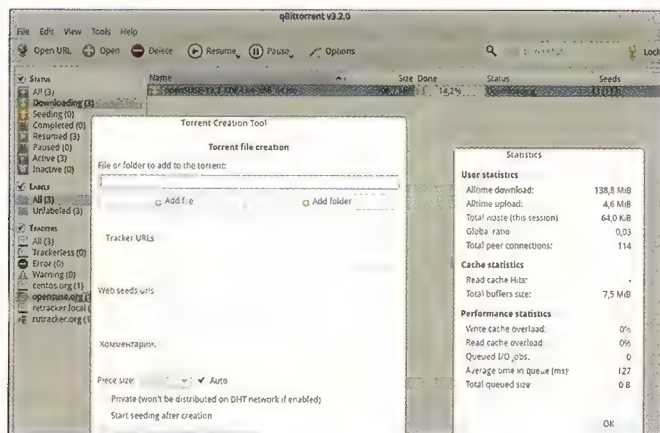




qBittorrent

Stay private.

FREE | WWW.QBITTORRENT.ORG



The open source BitTorrent client qBittorrent is available for all major operating systems, but particularly Linux, where qBittorrent claims to be the closest counterpart to µTorrent.

It has a classic user interface, with the current torrent downloads in the main view and a functional sidebar with status, labels and a trackers list. The simplest way to use qBittorrent is to offer it a .torrent file, either by selecting a downloaded local file, or pasting an URL, and you can do both actions from the application toolbar. However, qBittorrent offers many features for advanced users. For instance, it supports almost all BitTorrent extensions, including DHT and Magnet/BitComet links, IPv6 addresses, uPnP and NAT-PMP forwarding (if you're behind a router), IP filtering, Ajax-based web interfaces, torrents sorting, queuing and more. The handy torrent search feature is very welcome as it enables you to make search queries across a wide range of supported trackers right inside qBittorrent. Users can also create new torrents themselves, thanks to the built-in wizard.

The new 3.2 version brings various fixes and improvements to the GUI, which can now be compiled against the Qt5 library (Note: the version in the screenshots is still on Qt4). Downloaded files are highlighted in Dolphin, Konqueror and Nautilus now and there's also a new 'Finished' status for downloads. There's also a new .service-file for Systemd (for using qBittorrent in noX mode), which supports downloading files into network locations and tons of various fixes. The application fits wonderfully into any desktop environment thanks to its streamlined Qt4/Qt5 interface and clean design. It can also be configured for continuous downloading instead of simultaneous mode, which is of great benefit for any user who is on a low-speed connection.

Getting qBittorrent is pretty easy – just look at your distro's repositories and find the right package. There are Ubuntu and Mint packages in the dedicated PPA (qbittorrent-team/qbittorrent-stable). You can also surf OpenSUSE OBS or Arch's AUR to find Qt5 builds for a seamless installation.

Alexander Tolstoy

Lollypop

FREE | TINYURL.COM/OJDXH8G

No, this is not mobile operating system, Android 5.0, but a music player with a very similar confectionery-based name. It's designed to fit just right into Gnome or any other GTK3-based environment with its clean design and large spaces between controls. Lollypop uses parts of Totem for parsing tracks metadata, creating playlists and playing from versatile media sources.

When the application is started for the first time, it automatically adds your home directory to its database and starts rustling your hard drive, so expect to wait for a while if your music library is very large. Lollypop manages your music collection with a focus on dynamically updated playback statistics. On the left pane, you'll find a set of categories, such as Popular Albums, Recent Albums, Random Album, as well as static All Albums, Radios and Playlists.

The last two are placeholders for user-created content as Lollypop doesn't come with a predefined set of network radio sites. Lollypop also benefits from modern GTK3 features, which enable you to change its colour scheme on the fly.

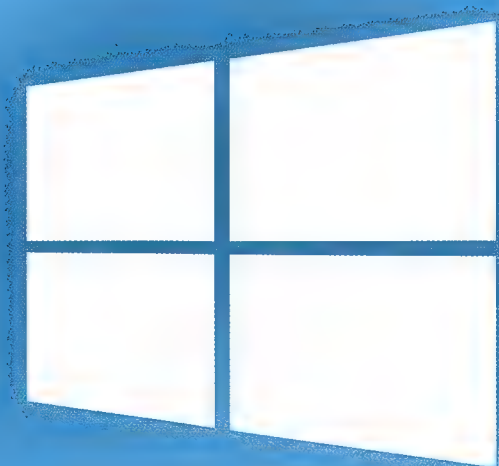
There's also the Party mode button, which shuts the lights down and turns the Lollypop window a dark shade of grey. The Gnome guidelines advise developers to use auto-lookup of the music library in the background, but Lollypop also has a dedicated Update music button (found in the Tools menu, in the far-right icon of the toolbar).

Album art is another feature that's supposed to be maintained manually, just select an album in any of the appropriate categories and then left-click its cover area. Lollypop will fetch the album cover art and will usually let you choose one from several variants.

Despite being simple to use and not excessively overloaded with features and options, Lollypop respects users' control of their music collections. Give it a try on your stylish GTK3-based desktop, and maybe you'll find that Lollypop will fit in better for you than Gnome Music and several of the other players. Lollypop is available pre-packaged for Arch, Fedora, OpenSUSE and Ubuntu/Debian. See the project's website for details.

Alexander Tolstoy





WINDOWS 10 IS HERE!

MICROSOFT'S BOLD NEW OS FOR PCs, TABLETS & SMARTPHONES HAS FINALLY ARRIVED... SO IS IT ANY GOOD?

YOUR QUESTIONS ANSWERED: WHAT'S NEW, WHAT WORKS (AND WHAT DOESN'T) + SHOULD YOU UPGRADE?

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MICROSOFT LAUNCHES WINDOWS 10

Almost 20 years after Windows 95 changed the world, Microsoft is back with Windows 10 – but has the world changed too much?

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HOW TO GET THE FREE UPGRADE

Confused about how the free Windows upgrade will work? You're not alone.

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WINDOWS 10'S NEW OLD START MENU

Microsoft has heard the roar of disapproval and the Start menu has returned. How does it work?

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WINDOWS 10'S LIGHTER, FASTER BROWSER

It wouldn't be a new Windows OS without a new browser.

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WINDOWS 10: UNDER THE BONNET

What are the big-but-invisible changes for Windows 10?

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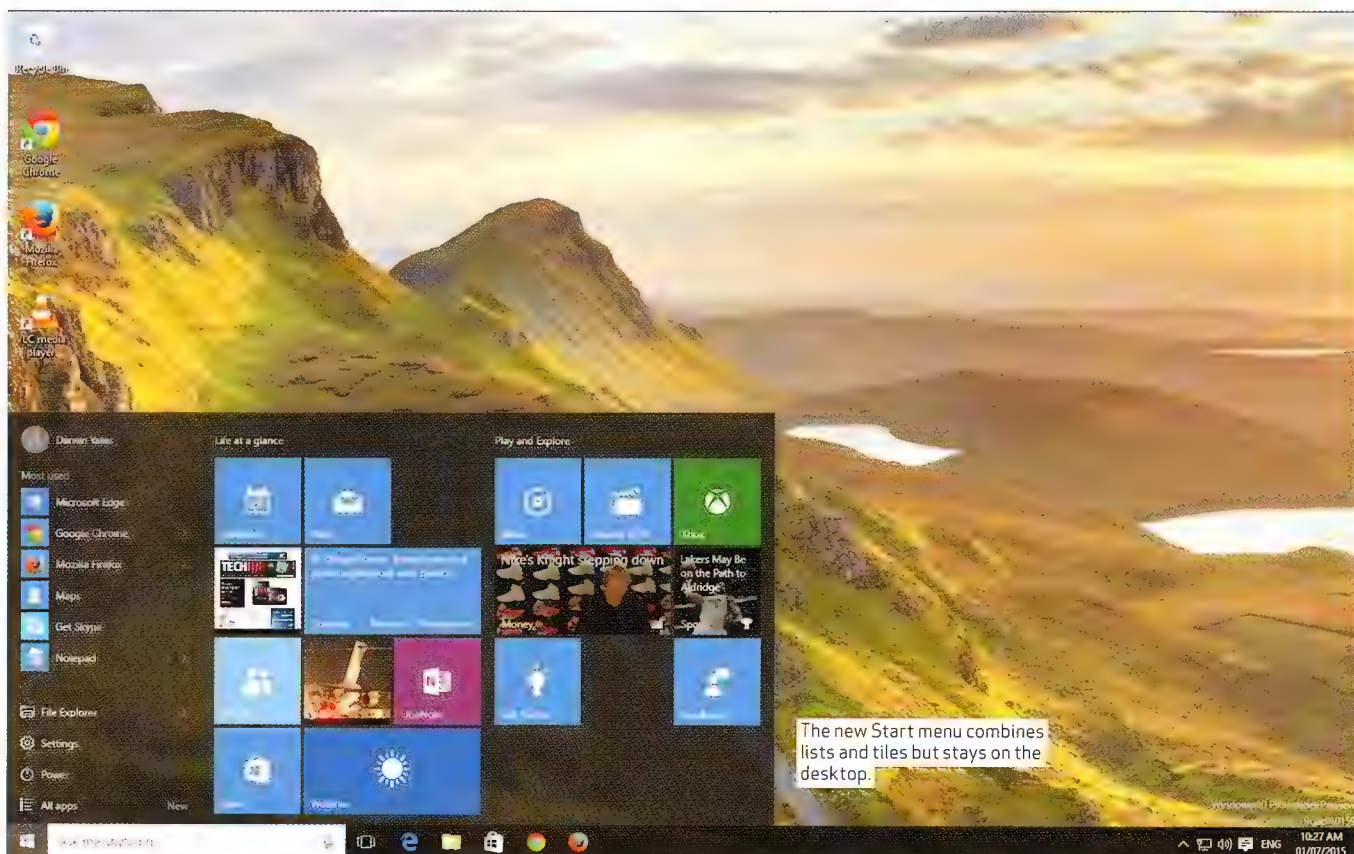
WINDOWS 10 TWEAKS & SECRETS

Get ahead of the pack with these mods and tricks for Microsoft's new OS.

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WINDOWS 10: THE REVIEW

It's loaded with changes, many improvements, but still the odd feature that makes us wince... plus some important unanswered questions.



Microsoft launches Windows 10

ALMOST 20 YEARS AFTER WINDOWS 95 CHANGED THE WORLD, MICROSOFT IS BACK WITH WINDOWS 10 — BUT HAS THE WORLD CHANGED TOO MUCH? DARREN YATES DIGS INTO THE LATEST RELEASE OF THIS ICONIC OS.

It's hard to believe but come this August, it'll be 20 years since the release of Microsoft's game-changing Windows 95 OS. And a game-changer it was, turning the PC from a business and enthusiasts' box of tricks into the device all of a sudden everyone had to have. In that first year, Microsoft sold 40million copies of Windows 95 and the consumer PC market took off.

Wind the clock forward to 2015 and Microsoft is setting up, hoping to do it all over again with the launch of Windows 10 on July 29. However, this time around, the landscape is all but unrecognisable from those glory days and the challenges are immense. The PC has fragmented into a million different devices where Microsoft is just one brand clamouring to be heard, its share of the global smartphone market has fallen below 3%, and hardly a week seems to pass without some pundit declaring PC sales are collapsing.

Adding to its dramas, Microsoft's last Windows outing arguably did as much to advance the cause of smartphones as the phones, themselves. The decision to kill off the Start button seriously underestimated how important this

feature was to millions of users. While geeks and Windows fans learned to love the new Start Screen, the backlash likely kept many consumers hanging onto their ageing Windows 7 systems, hoping that sanity — and the Start button — would one day return.

WINDOWS EVERYWHERE — MK II

In Windows 10, Microsoft is aiming to cover all of these issues, but the company's prime target is this fragmented computing landscape. The company tried to lasso it with Windows 8, but with the market even more fragmented this time around, Windows 10 has an even broader remit, gunning for desktops, tablets, smartphones, Microsoft's new HoloLens, the new Raspberry Pi 2, Internet of Things (IoT) devices and even the computationally-diminutive Arduino microcontroller. In other words, just about anything that computes.

It's being made possible by a major overhaul of the Windows codebase and the creation of what Microsoft calls the Universal Windows Platform (UWP), a basic set of programming access points or 'interfaces' common to all versions of the new OS. The biggest benefit of UWP

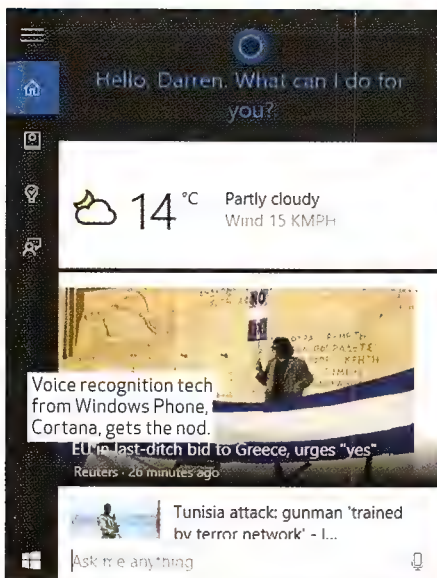
will be 'universal apps', apps with a single codebase capable of running on many of those devices.

In fact, app developers are amongst the biggest winners in Windows 10 — and not just Windows app coders. Aside from the universal apps concept, Microsoft is also putting the final touches on some special toolkits for iOS and Android app developers to help them port their apps to Windows Phone. The potential here is enormous and reportedly, gamemaker King has jumped on board, trialing the technology to port *Candy Crush Saga* to Windows 10.

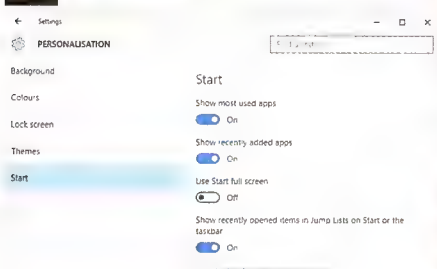
BACK TO THE FUTURE

But at the same time, Microsoft must also repair the angst amongst Windows 7 users and that starts with the new Windows 10 Start menu. Frankly, it's a tall order for it to appeal to everyone, as Microsoft appears to have the new Start menu trying to bridge the divide between Windows 7 Start menu and Windows 8 Start Screen.

The first thing Microsoft has right this time is that the Start menu keeps you on the desktop. Second, Modern UI apps can now open as desktop apps.



Windows 10 received a new login screen in Preview Build 10159.



Windows 8 Charms are dead; in its place, the new Settings applet.

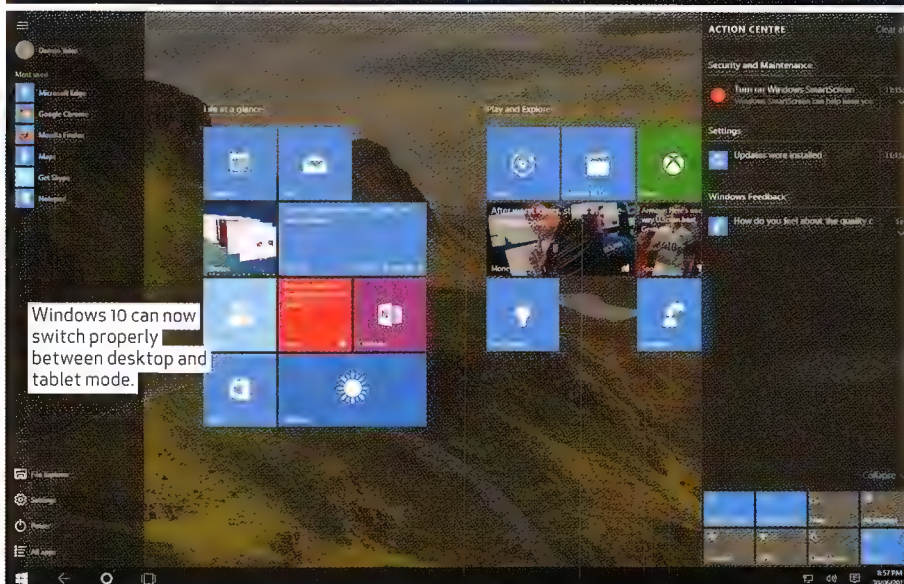
Add the new Cortana voice-recognition digital assistant parachuted in from Windows Phone and while it might not please everyone, this Start menu certainly has features galore.

NEW GAMING

Gamers and game developers aren't left behind either with some major bodywork happening to Windows gaming in the shape of new DirectX 12. In fact, DirectX 12 looks properly impressive and should give game coding a significant shake-up, not just in performance but importantly, in improved battery life. By providing closer access to the GPU's raw functions, game developers will have the ability to squeeze out faster frame rates from the same slab of silicon, or alternatively, achieve the same performance with noticeably reduced power consumption. That alone should have a significant positive impact on Windows Phone and Surface Pro 3 devices (not to mention the sea of Windows 10 notebooks and tablets nearing the start line). There's also very clever tech called Multiadapter, enabling discrete and integrated GPUs to work side-by-side for the first time.

NEW BROWSER

The software giant has also signalled it's getting ready to call time on Internet Explorer with the first release of an



Windows 10 can now switch properly between desktop and tablet mode.

"The decision to kill off the Start button seriously underestimated how important this feature was to millions of users."

all-new web browser called Microsoft Edge. Internet Explorer 11 will still appear in Windows 10 to keep enterprise and business customers happy, but Edge will now be the default browser, featuring a new, trimmed Trident-based render engine that's already proving to match Google's Chrome and Mozilla Firefox for processing speed. But it's Edge's very cool new 'inking' feature that allows you to draw, highlight or annotate webpages – Microsoft calls them 'web notes' – that should turn heads.

FREE* UPGRADE

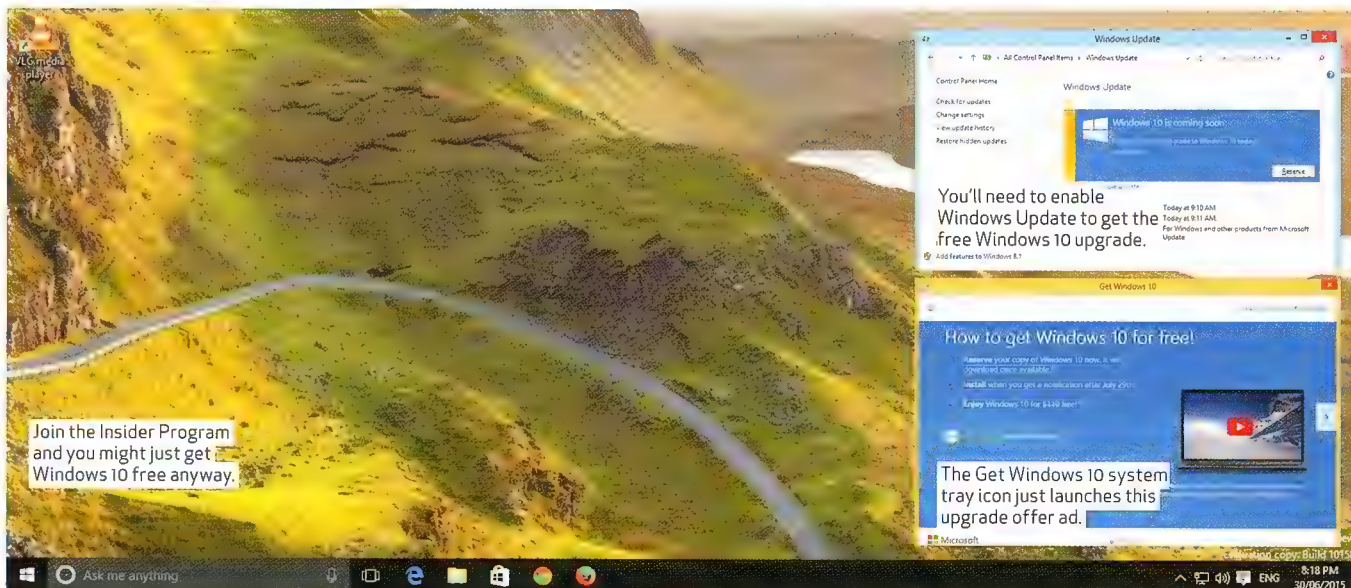
In fact, so serious is Microsoft in righting the Windows ship, the company will offer a free Windows 10 upgrade to all genuine-licensed Windows 7 and Windows 8.1 consumer devices. It'll also cover Windows Phone 8.1 with an upgrade to the new Windows 10 Mobile.

However, the company seems to have struggled to word this offer well, leading to confusion and reports of 'Windows-as-a-Service' and the free

upgrade becoming a subscription service after the first year. Actually, with Microsoft's plan to provide continual updates to Windows 10 – and the growing rumours it will be the last discrete version you buy – it's likely at some point in the future, Windows could become a subscription service. But for this free upgrade offer, the word from Microsoft is this – you'll have a year to download it free-of-charge, but once installed, you'll have a free license for that install, valid for the life of the device, again free-of-charge.

READ ON...

Add to all of that the new virtual desktop feature called Task View, the new Action Centre, lots of new tricks and there's plenty to talk about. Even at this pre-release stage, Windows 10 looks to be one of the more polished iterations of the OS Microsoft has produced. But as we'll see, there are features and issues we're definitely not happy with, so join us as we rip the cover off, peer inside and see what all the fuss is about. ■



How to get the free upgrade

CONFUSED ABOUT HOW THE FREE WINDOWS UPGRADE WILL WORK? YOU'RE NOT ALONE. DARREN YATES EXPLAINS WHAT'S INVOLVED.

Unfortunately, Microsoft hasn't made a great fist of explaining how the free Windows 10 upgrade will work and given the emails we've received from readers, it seems there are still more questions than answers. So, here's what we know so far:

WINDOWS XP/VISTA

There is no upgrade path from XP or Vista to Windows 10. But, sign up to Microsoft's Insider Program with a valid Microsoft account, clean-install the latest Windows 10 Preview Build from an ISO image and – most importantly – continue in the Insider Program after July 29 and it seems Microsoft will for all intents and purposes allow you an on-going Windows 10 install. You'll, of course, have to put up with bugs, fixes and, in all likelihood, Microsoft monitoring, but it's one way to get ongoing pre-release beta-grade Windows 10 for free (tinyurl.com/p8z5uhn).

WINDOWS 7/8.1

If you have a genuine-licensed Windows 7 SP1 or 8.1 install that isn't Enterprise edition, you should qualify for a free final-release upgrade. Aside from any hardware incompatibilities preventing upgrading, it'll work like this – users with Windows 7 Starter, Home Basic or Home Premium or Windows 8.1 will get Windows 10 Home; those on Windows 7 Professional or Ultimate or Windows 8.1 Pro, Pro Student or Pro WMC will upgrade to Windows 10 Pro.

However, all upgrades will need the following:

- 3GB of download bandwidth
- Windows 7 SP1 or Windows 8.1 updates preinstalled.
- Windows Update enabled
- You must upgrade within one year.

IS THE UPGRADE FREE OR NOT?

This last point has caused some to think after one year, the free upgrade will become a subscription fee. It's not to say Microsoft won't have Windows-as-a-Service sometime in the future, but on current info, if you have what Microsoft considers a 'genuine' licensed install of Windows 7 SP1 or 8.1, the upgrade will be freely available to download for one year, but the upgraded installation will remain free to use for the life of the device. (tinyurl.com/nnjzbmz).

While the Preview Builds have been made available as ISO images, we have no word that the free final-release upgrade will be available this way – but it's possible.

UPDATE BEFORE YOU UPGRADE

As we've noted, if you haven't updated to the latest versions of Windows 7 SP1 or 8.1, you must do so before the Windows 10 upgrade can begin. We've been asked if you can install Windows 8.1 fresh from install media and use a Windows 8 key. The answer is typically 'no' – you need a Windows 8.1 key. However, there may be (complicated) ways around this – we don't have space to cover it here, but check out this HowToGeek tutorial (tinyurl.com/mjppzab).

GET WINDOWS 10 ICON

Finally, noticed the new 'Get Windows 10' icon in your system notification tray? One reader feared accidentally clicking on it would lock-in the upgrade. It doesn't – it just launches the upgrade offer app. You have to click the 'Reserve your free upgrade' button, then enter your email address in the app window before anything happens. ■

Upgrade from Windows 7*

From Edition	To Edition
Windows 7 Starter	
Windows 7 Home Basic	Windows 10 Home
Windows 7 Home Premium	
Windows 7 Professional	Windows 10 Pro
Windows 7 Ultimate	

Upgrade from Windows 8**

From Edition	To Edition
Windows 8.1***	Windows 10 Home
Windows 8.1 Pro	
Windows 8.1 Pro Student	Windows 10 Pro
Windows 8.1 Pro WMC	
Windows Phone 8.1****	Windows 10 Mobile

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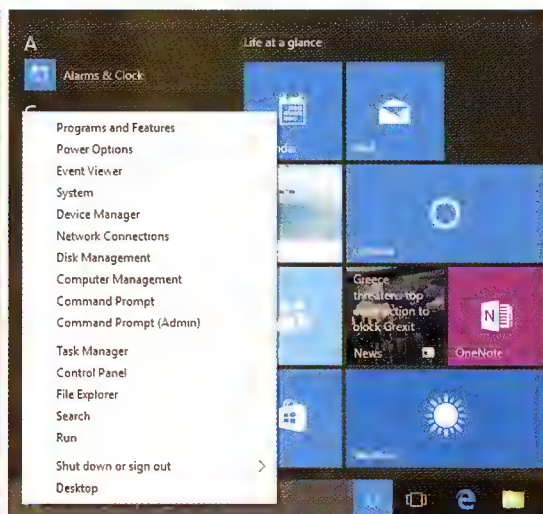
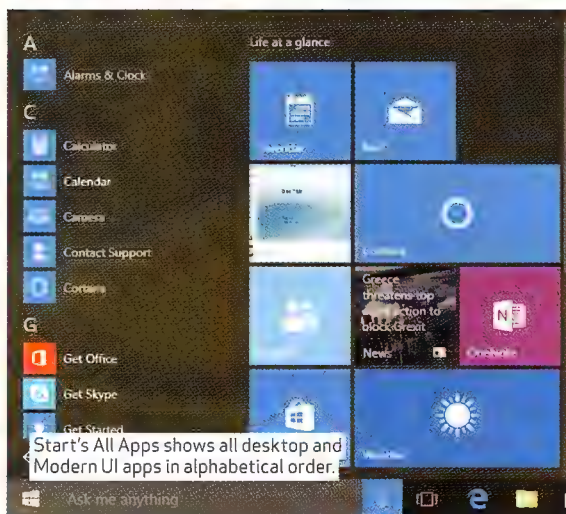
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Windows 8's right-click context menu still accesses all the inner goodies.

Windows 10's new old Start menu

MICROSOFT HAS HEARD THE ROAR OF DISAPPROVAL AND THE START MENU HAS RETURNED. SO HOW DOES IT WORK? **DARREN YATES LOOKS AT THE CHANGES.**

We reckon there'll come a day when Microsoft looks back on Windows 8 and admits the decision to remove the traditional Start menu was far from one of its best. Sure, plenty of geeks were happy to use Modern UI, some even preferred it, but I've seen nothing in 20 years galvanise Windows users quite like losing that little Start icon.

To its credit though, Microsoft heard the clamour and threw it back into the 8.1 update, but yet somehow missed the point – using the prized Start button to launch the Modern UI Start Screen was like a 'red rag to a bull' to those who hated Modern UI, with many simply heading straight off to install Classic Shell (classicshell.net).

THE NEW, OLD START MENU

Still, Modern UI was always a major plank in Microsoft's plan for ruling the world from desktop to smartphone, but with Windows Phone 8's market share

languishing below 3% (tinyurl.com/nqedmxk), it clearly still has a long way to go on that goal.

However, Windows 10 proves Microsoft doesn't have a tin ear and given the divergent goals of bringing smiles back to Windows 7 users and forging on with Modern UI, it's brought back a more traditional Start menu we've christened the 'new old Start menu' – and realistically, it's probably as good a compromise as you'll get.

By default, the new old Start menu keeps you on the desktop – no flying off into a Modern UI parallel universe, thank goodness. In fact, what's great about Windows 10 is that Modern UI apps now initially fire up on the desktop – select the Tablet Mode option on the new Action Centre panel and Windows 10 switches to a more suitable Modern UI feel. It's a much more intelligent switching method that puts control back into the hands of users. In other words, if Windows 8 pushed the pendulum too far towards

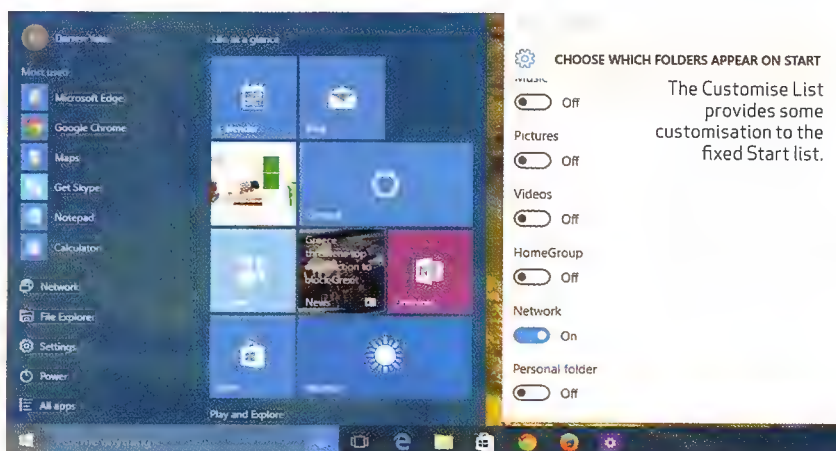
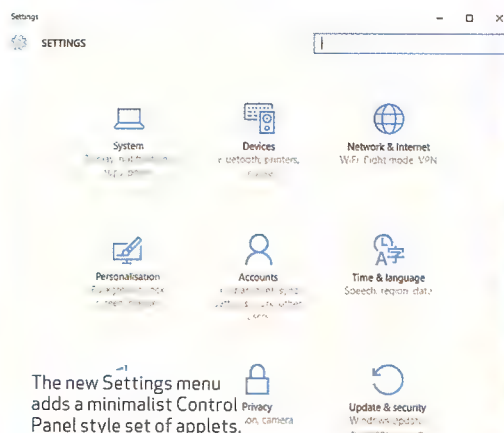
Modern UI, Windows 10 is nature swinging it back again.

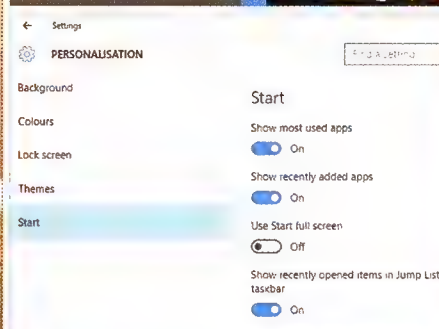
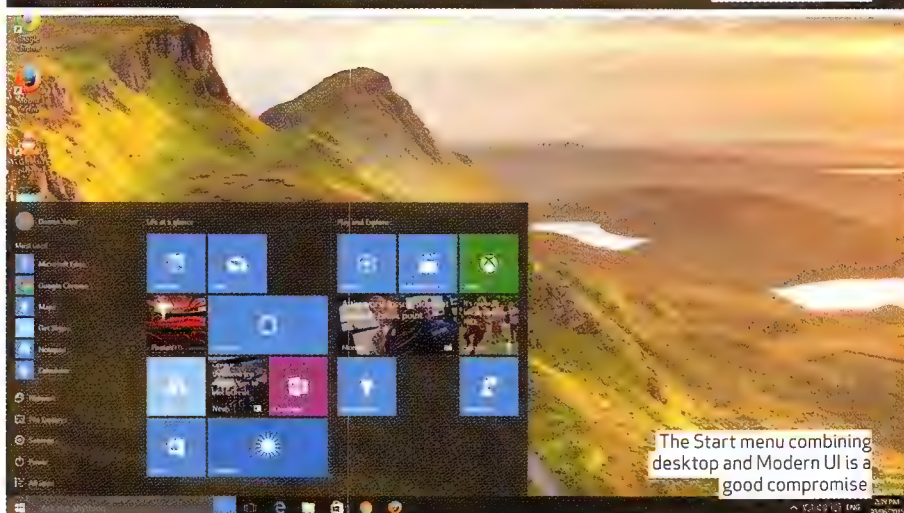
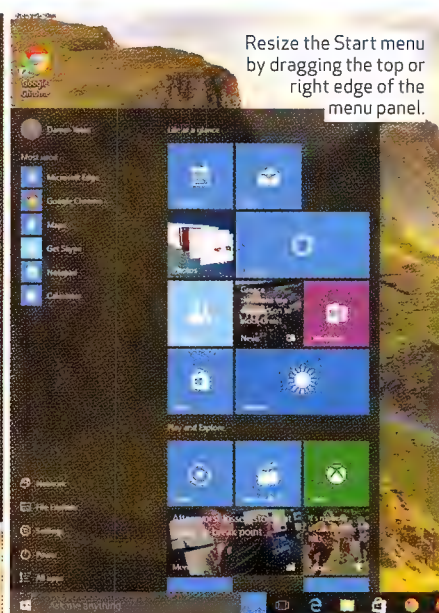
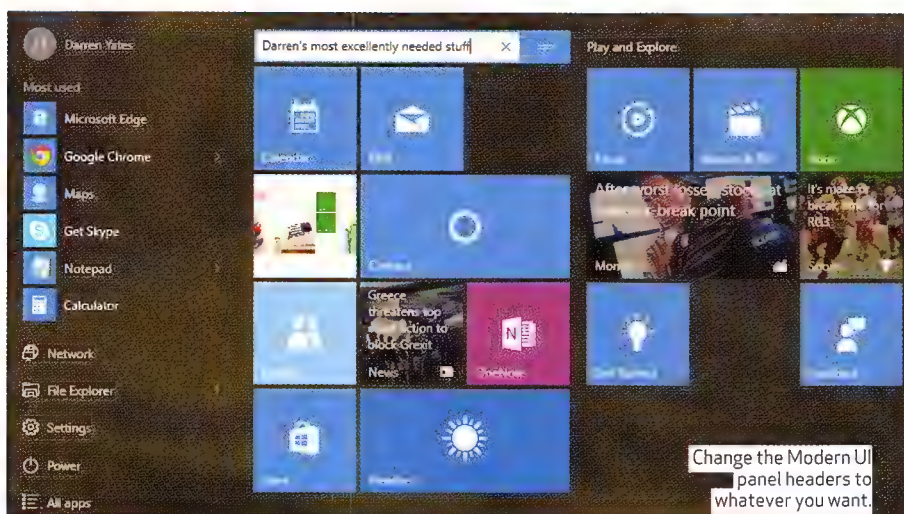
HOW IT WORKS

The new old Start menu's default setup features your 'Most used' apps down the left-side menu, followed by your most 'Recently added' apps and finally, a basic control set that includes File Explorer, Settings, Power and All Apps. This last entry turns the whole left-side menu into an alphabetical list of all your apps – desktop and Modern UI – with a Back button to return.

Now unfortunately, while File Explorer brings up the traditional desktop app, Settings is seemingly a more Modern UI replacement for the old Windows 8 charms. Personally, I'm glad it's not called Control Panel – I'd be about ready to toss the toys out of the pram if it was.

However, Microsoft has been clever enough this time not to go to ballistic with the changes – at least this far into the Preview builds. Right-click on the





Start menu options are now found under Settings > Personalisation.

Windows icon and you still get the excellent power user menu from Windows 8 – in fact, it's identical with all of the same desktop twiddly-bits, from Admin-rights command prompt to the proper Control Panel.

NOT YET PERFECT

But there are still a few high-visibility vests and hard hats around the Start menu, even as of Build 10158. For example, right-click on an empty part of the taskbar, select Properties from the context menu to bring up the common 'Taskbar and Start Menu Properties' applet – only, there's no Start Menu tab. Instead, it's moved to 'Settings > Personalisation > Start' in the Start menu. The only option in the Navigation tab so far is to replace Command Prompt with PowerShell in the power user menu.

QUICK CUSTOMISATION TWEAKS

However, there's still a decent level of customisation available in this new Start menu – it's not perfect, but not bad either. Here are a few tricks to get you warmed up:

It's resizable. Don't like the default menu panel size? No probs – just grab the top or right-edge of the panel and drag to resize it. The top edge is

continuously adjustable; the right-edge collapses the Modern UI panels into a single scrollable vertical panel.

Turn off live tiles. Not everyone loves Modern UI's live tiles, you can right-click on an offending tile and choose 'Turn live tile off'. The same context menu can also pin that app to the taskbar, resize the tile, unpin it from the Start menu and uninstall the app.

Change the Modern UI header titles. Don't like the default 'Life at a glance' and 'Play and Explore' panel headings? Click on them and type in your own.

Change the menu accent colour. If you're not thrilled with the gunmetal-grey colouring, head to 'Settings > Personalisation > Colours' and select the accent colour you prefer from the colour chart, or let Windows automatically pick a colour accent from your desktop background image. Don't forget to throw the switch for 'Show colour on Start, taskbar and action centre' to 'on' as well.

Customise the left side menu. Yes, you can customise it, but only from a limited set of options at the moment. Head to 'Settings > Personalisation > Start' and select 'Choose which folders appear on Start'. You'll see File Explorer and Settings are in by default, but also available are Documents,

Downloads, Music, Pictures, Videos, HomeGroup, Network and Personal Folder. But that's it. Remember, the real inner-sanctum controls are just a right-click away on that Windows Start icon. Still, Control Panel on the Start list would've been nice.

Switch to tablet mode. Using Windows 10 on a tablet is now much easier. Open the new Action Center and hit the Tablet Mode button to switch to Modern UI full-screen mode (also works on notebooks).

Run as administrator. Right-click on a non-Modern UI desktop app in the Start list and you can choose to launch it in elevated-privileges 'Run as Administrator' mode.

WHAT DO WE THINK?

The lack of Control Panel as an option to add to Start's fixed menu list is a bit of an oversight in our view. However, the fact the Start menu no longer has to send you off into Modern UI's parallel universe is a definite plus. More customisation options would always be better, but provided Microsoft keeps the right-click power user menu on the Start button, we think this new Start menu is at least a much more workable solution for desktop devotees than Windows 8.1. ■

Windows 10's new lighter, faster browser

IT WOULDN'T BE A NEW WINDOWS OS WITHOUT A NEW BROWSER. DARREN YATES EXPLORES NEW INTERNET EXPLORER-REPLACEMENT CALLED EDGE.

Internet Explorer has long been an object of derision amongst PC users over the years, whether it's the security holes, the variable performance or its wobbly adherence to web standards. But incredibly, as of May this year, it still maintained more than 55% desktop market share, according to the latest available data from NetMarketShare (tinyurl.com/6umm2xe).

NEW WEB BROWSER

But Microsoft is taking the opportunity with Windows 10 to completely revamp its web browser components. First, it'll feature a new web browser, originally called 'Project Spartan', now known as Microsoft Edge. But second, it'll also come with a new web render engine. Well, sort of.

Since Internet Explorer 4.0, Microsoft has used its own proprietary engine called 'Trident' to render web pages – and it continues to do so with IE11. However, Edge will come with its own new rendering box of tricks. It turns out Microsoft engineers have taken Trident and hacked away the deadwood that was IE5.5-through-IE10 legacy bloatware to create a new light, lean engine with an IE11-only codebase (tinyurl.com/k39t7s6). And the performance so far is looking rather good.

NEW FEATURES

The new Edge browser is also one of the first examples of Microsoft's new Universal Apps Platform, an app that will work on any version of Windows 10 with a GUI – desktop, mobile, even

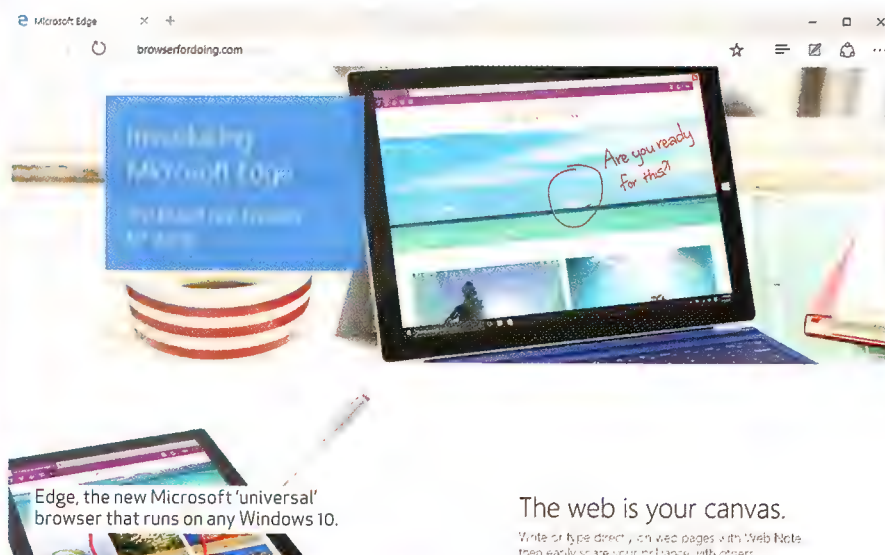
Xbox One. It has baked-in access to Cortana, Microsoft's new voice-recognition digital assistant, but the most obvious addition is the 'inking' feature, which allows you to draw, highlight and annotate right on the webpage. You can then share your 'web notes' with others via social networking or save them as favourites within the browser.

Apart from sharing your Web Notes, a new feature built into Windows 10 Preview Build 10158 is the ability to send them to OneNote, Microsoft's note-taking app available in this preview.

One last surprising but welcome new feature will be Edge's faster update schedule – Microsoft is calling it 'regular', which will make a nice change from previous efforts.

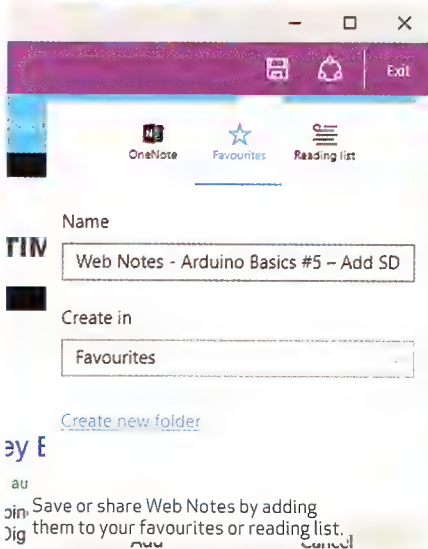
MORE CONFUSION

Windows 10 will include both IE11 and Edge, but when Microsoft first announced Project Spartan back in January 2015, it had planned to have the new Edge engine work on both browsers, switching automatically to the IE11/Trident engine when it detected legacy webpages. However, it seems after being hammered by user feedback, the company has hurriedly decided to keep the two browsers completely separate – Edge as the default browser with the new engine, while IE11 sticks with the old Trident engine. Based on Microsoft's blog entries, it seems IE11 with dual-action rendering engines may have frightened enterprise users, so much so that Microsoft is now at pains to say



The web is your canvas.

Write or type directly on web pages with Web Note. Then easily share your creations with others.



Arduino Basics #5 – Add SD storage to Arduino

by Darren Yates May 19, 2015

4 Comments

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basic steps of who

Arduino Uno's microcontroller board is great, but the one thing it's not overly generous with is storage.

Having 32KB of program flash storage, 2KB of RAM and 1KB of programmable EEPROM space at your disposal is fine for many Arduino projects, but it's not

Draw on web pages using Edge's Web Note function.

card reader module from eBay, you can quickly add up to 32GB of space. What's more, FAT32 software libraries for Arduino mean you can

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IE11 will remain 'fundamentally unchanged from Windows 8.1' (tinyurl.com/q6fsvhr).

As of Build 10158 of Windows 10 Pro, you can find IE11 in the new Start menu, but only under 'Windows Accessories'. Edge also comes with a similar stylized 'e' icon but without the gold ring.

PERFORMANCE

One thing certain is Edge delivers considerably improved performance and HTML5 support over IE11. We tested the latest available 20.10158.0 version of Edge up against the Internet Explorer 11.0.10158.0 release in Windows 10 Preview, in addition to Chrome 43.0.2357.130m and Firefox 39 Beta 7.

Overall, two things stand out from our tests – first, Edge is clearly faster than IE11, except on WebKit's SunSpider 1.02 Javascript benchmark, where Microsoft already handsomely leads everyone else. But second, Edge has basically caught up to the performance levels of Chrome and Firefox – the differences on Octane 2.0 and Kraken 1.1 between Edge and the rest are minimal.

As for HTML5 support tested through HTML5Test.com, Edge shows significant improvement here as well. However, while it's now not far short of Firefox in that regard, there's still a decent jump to the latest Chrome 43 from Google.

HOW-TO: CREATE WEB NOTES

The Edge release in Build 10158 of Windows 10 Preview has improved in the last couple of updates and Web Notes now work on many more web sites. If you're keen to try it out, here's what you do:

STEP 1: Fire up Edge and load up a web site. Next, select the notepad icon on the top-right of the browser – this pulls in Web Note's new purple function menu across the address bar.

STEP 2: On the top-left, you'll now find the basic controls including opaque (solid) marker and a transparent highlighter. You can choose the colour of each by clicking on the appropriate icon a second time to launch the colour picker. Now just click and drag your cursor to draw on the page.

Next, there's the eraser tool to wipe away what you've done, followed by the typed note control. This turns the cursor into a cross-hairs icon and you

The collage illustrates the integration of Web Notes into Microsoft OneNote. It shows the 'Arduino Basics #5' article in the Edge browser, the OneNote application with a Web Note embedded, and a detailed view of the article content which discusses adding SD storage to an Arduino Uno.

just click in the approximate location of the page where you want your note to sit. Once the box is created, click inside and type your note. The rubbish bin icon inside deletes the typed note and the small numbered tag icon on the top left lets you drag the box anywhere on the page, but only before you save the Web note.

STEP 3: When you're done, choose the disk icon on the top-right to save your web note, or the link-circle icon to share it with others. Edge stores the web note as a 'favourite' within the browser and as of Build 10158, default-stores it in the `<user>/AppData/Local/Packages/Microsoft.MicrosoftEdge` subfolder.

ADVANCED SETTINGS

Because Edge is brand-new, Microsoft continues to tinker with it in the various Preview Builds we've looked at. Some of the old Advanced Settings

from Build 10130 are now missing from Build 10158, such as no more 'experimental features' options. The new Advanced Settings menu is now an offshoot of the Settings menu (top-right three-lines icon). Here, you can choose settings such as turning on and off Adobe Flash Player. There's also an option to replace Bing as the default address bar search option, although it's greyed out in Build 10158.

WHAT DO WE THINK?

Given we're only testing the Build 10158 Preview release, we'll hold off on our final judgment of Edge until we get final-release code, but so far, it actually looks surprisingly good, performs much closer to HTML5 standard and has lots of zip. Is it more secure than IE11? We'll have to wait and see. ■

WINDOWS 10 WEB BROWSERS HOW THEY PERFORM

	MICROSOFT EDGE 20.10158.0	IE 11.0.10158.0	GOOGLE CHROME 43.0.2357.130M	MOZILLA FIRE- FOX 39.0 BETA 7
SUNSPIDER 1.02 (MILLISECONDS)	136.9	134.7	259.1	270.6
OCTANE 2.0 (SCORE)	19786	10045	19524	20417
KRAKEN 1.1 (MILLISECONDS)	1813.6	2996.8	1722.4	1850.4
HTML5TEST (SCORE)	402	348	526	447

NOTE: SUNSPIDER AND KRAKEN - LOWER SCORES ARE BETTER; OTHERWISE, HIGHER SCORES ARE BETTER.

NOTE: TEST ON 3GHZ INTEL CORE I5-2300 WITH 4GB OF RAM, 120GB KINGSTON HYPERX 3K SSD, WINDOWS 10 PREVIEW 10130

Windows 10: under the bonnet

WHAT ARE THE BIG-BUT-INVISIBLE CHANGES IN WINDOWS 10? DARREN YATES DIVES UNDER THE BONNET TO FIND OUT WHAT MICROSOFT HAS TINKERED WITH.

While Windows 10 comes with obvious changes like the new web browser and Start menu (more on these elsewhere), what other technical changes are there inside the OS that may affect you? Not surprisingly, Windows 10 has plenty of new tech, none more critical than the one you've probably heard least about – a new shared-component platform called Windows Core (tinyurl.com/q7vdbcq).

WINDOWS CORE

You won't notice anything from the desktop, but lift the bonnet and Windows Core looks to be as fundamental a shift in the way Windows works as anything since the jump to Windows XP back in 2001. It's the culmination of a platform change begun with Windows 8 and the unified kernel, the single binary engine now running everything from the desktop to Xbox One. But with Windows Core, that common kernel now expands to a common platform of modular shared components that can be added to or stripped back to suit to the intended device. It means the desktop, phone and Xbox One, even the Raspberry Pi 2 all start with this common Windows Core and build from there.

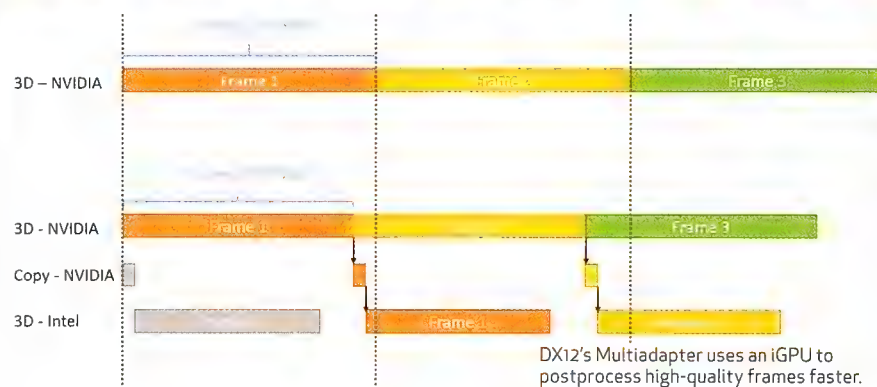
The keys for software developers into this Windows Core is what Microsoft calls the Universal Windows Platform (UWP), a set of core application programming interfaces (APIs) that are consistent across all Windows 10 devices (tinyurl.com/o3eprfz).

UNIVERSAL APP PLATFORM

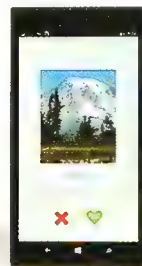
Taking this a step further, a key benefit of the Java programming language has always been its 'write-once-run-everywhere' mantra enabling coders to write one source code and launch it on any computer that can run the Java run-time engine.

UWP builds this idea into Windows 10 at the lower API level rather than as a run-time layer in the style of Java.

But it's the universal application platform (UAP) that Microsoft is hoping to score high marks with. The way Microsoft describes it, developers will have to write just one app that has one set of business logic and one user interface to submit to the one Windows app store as one package (tinyurl.com/ohsduqc). And that app will then run on anything from desktop down to phone, Xbox One, even HoloLens, through



Windows 10's Project Astoria refactors Android apps into Windows 10 apps.



Adaptive UX, a new tech that adapts the user interface and controls to different devices at run-time. Microsoft's up-coming Office 2016 suite, for example, consists of all UAP apps (tinyurl.com/owvlyng).

PROJECTS ISLANDWOOD, ASTORIA

A story that's had a few people overexcited recently is the one about being able to run iOS and Android apps

on Windows 10 devices. This is actually true, but not as simple as 'download and run'. Project Islandwood (tinyurl.com/nax7awc) provides iOS developers with a UWP 'bridge' toolkit to create Objective-C (iOS) apps but also cross-compile them into Windows apps using Visual Studio 2015 RC. Project Astoria (tinyurl.com/oxqr4jq) is the codename for Android RunTime (ART) apps on Windows 10 – it can even test how much of your Android APK code can be reused. It's clever stuff – developers can maximise much of their existing code for Windows 10 apps without reinventing the wheel. The projects will be available after the Windows 10 launch.

DIRECTX 12

Of course, Windows 10 also has plenty for gamers. For starters, it's the exclusive OS for DirectX 12, the latest version of Microsoft's multimedia extensions. This iteration of DirectX

SPLIT-FRAME RENDERING
SUPREMELY RESPONSIVE MULTI-GPU GAMING

DIRECTX® 11
Multi-APU video architecture (AVP) renders lower frame rates, rendering speed is slower for the lower 1000 GPU's already rendering a lower frame rate, even when rendering multiple frames in a single frame (FPS) rendering speed is slower than the single GPU's rendering speed.

DIRECTX® 12
New mode available to device, split-frame rendering (SFR). Each frame of a game is split into 2 tiles. Each GPU in the system renders one tile. Frames are no longer held to be queued time between frame completion and user viewing reduced by 2-3x. Using the GPU's in parallel to work on one frame allows multiple GPUs to behave like one much more powerful GPU.

DX12 allows split-frame rendering (SFR) when using multiple discrete GPUs.

DX12 Unreal Engine Race to 635 frames

Using the iGPU for postprocessing adds 10% frame speed in early testing.

Multi-Adapter: Discrete + Integrated

00:00:17.68

00:00:15.98

35.9 fps

39.7 fps

Winner: Multi-adapter

also marks a significant change, providing game developers with a much lower-level of code access to GPU silicon for higher-performance gaming. And there's no mucking around here – Nvidia's DirectX 12 drivers are already WHQL-certified, but you'll need a Kepler-class GPU (GeForce 600-series 'GK') or newer. AMD users need a Radeon HD 7000 series GPU or newer, or a Kaveri-class APU.

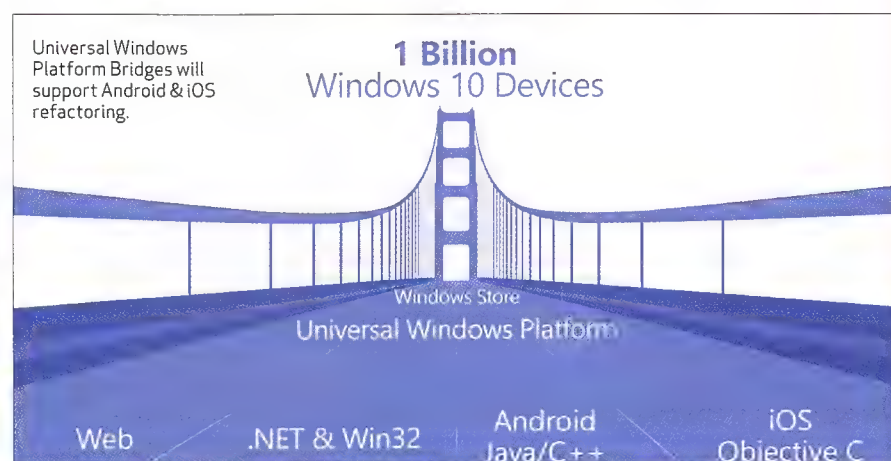
Microsoft says it's aiming for 'console-grade efficiency', but early testing by Intel already suggests significantly reduced CPU power consumption, greater than 50% on a Microsoft Surface Pro 3 (tinyurl.com/nwtcmgk). That'll no doubt lead to better gaming battery life for Windows 10 notebooks, tablets and phones.

It turns out there'll also likely be a DX12 subset for older systems called 'DirectX 11.3'. However, we think it'll lack the CPU efficiency tech and Microsoft has up-front caveats on what it might finally include (tinyurl.com/p4t3nfr).

DISCRETE + INTEGRATED

But arguably the most impressive addition is the ability to combine discrete and integrated GPUs into live gaming. It's a new DirectX 12 tech called 'Multiadapter', which aims to bring your CPU's integrated graphics engine back into service alongside your GeForce or Radeon graphics card. Most major game engines, including Epic Games' Unreal Engine 4 (UE4), should support this new feature.

Microsoft explains it with this workload timeline – the discrete (main) GPU will handle the main frame rendering, but instead of throwing the results straight to the screen, the iGPU will first add postprocessing effects (think HDR-lighting when you set 'very high' game quality). Once the iGPU finishes postprocessing, the frame is displayed. In a single-GPU setup, that postprocessing slows down the frame rate, but with Multiadapter, the discrete GPU is already rendering the next frame as the iGPU completes post-processing on the previous one.



Results so far indicate a 10% boost in game frame rates with postprocessing effects on early UE4 tests (tinyurl.com/l6pqarr) – not bad for no extra cost.

Thinking this sounds ripe for a discrete GeForce/Radeon GPU combo? Microsoft has said nothing official about the idea yet (despite rumours), so we'll have to wait and see.

ENTERPRISE-GRADE SECURITY

You won't have had to use a computing device for long to know that no operating system is perfectly secure. The last 12 months alone should be proof enough of that. So, it's good to see Microsoft has given Windows 10 some enterprise-class security features, including new two-factor authentication (TFA), a fancy way of saying a Windows 10 system will provide its own key in addition to your

password, PIN or fingerprint for added security. It should drastically reduce your chances of being successfully hit by a 'drive-by' internet attack because the hacker would need access to your physical system plus your password, PIN or fingerprint to get in (tinyurl.com/krse77j).

It's one of a number of enhancements added to convince enterprise users Windows 10 is a must-have upgrade (alternatively, companies with their own public-key infrastructure (PKI) security will be able to use it in place of Windows-generated TFA.)

Another feature is Device Guard, a trusted-app signing and protection service that can send a device into lockdown against persistent threats. So far, it has the backing of big-name brands including Acer, Fujitsu, Lenovo, HP and Toshiba (tinyurl.com/q3w8wyo).

Windows 10: tweaks & secrets

GET AHEAD OF THE PACK WITH THESE MODS AND TRICKS FOR MICROSOFT'S NEW OS.
DARREN YATES REVEALS THE TOP TIPS FROM BUILD 10158.

CHANGE THE COMMAND PROMPT OPACITY

Windows 10's command prompt has a new trick – adjustable window opacity. Right-click on the command prompt header, select Properties, choose the Colours tab and at the bottom, drag the Opacity slider left to make the command prompt window progressively more see-through. Very handy if you still need to see what's behind the prompt.

PUT ALL WINDOWS 10'S HIDDEN GOD MODE

GodMode is a one-stop panel that gathers all Control Panel commands within Windows 10. Create a folder on your desktop (or documents folder, it doesn't matter) and rename it exactly:

GodMode-!ED7BA470-8E54-465E-825C-99712043E01C}

That means the period '.' and the curly braces '{' and '}'. Press Enter and the folder changes to the Control Panel icon and rename itself 'GodMode'. Use carefully.

DOWNLOAD MAPS FOR OFFLINE

You don't have to put up with spending your data quota on maps when searching for directions – you can pre-download maps for offline use. Select 'Settings > System > Offline Maps', press the '+' icon next to Download Maps and choose your country area to download. Currently, Australia is a 461MB download, while New Zealand maps will cost you 110MB of space.

PEEK AT THE DESKTOP FROM THE TASKBAR

It's quite a bit skinnier than it was on Windows 8, but the Show Desktop button still exists on the Windows 10 taskbar – it's at the far right end. By default, it shows the desktop, but right-click on the skinny button and choose 'Peek at desktop'. Now when you roll the cursor over it, it'll show the desktop and revert back when you move away.

WINDOWS 10'S VIRTUAL DESKTOPS

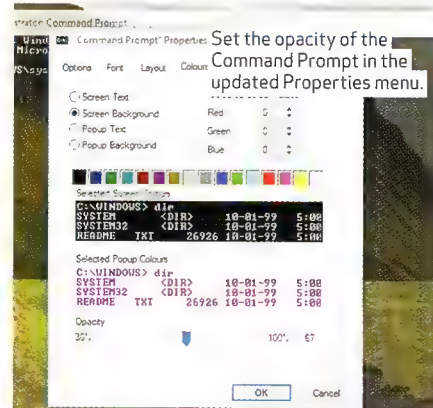
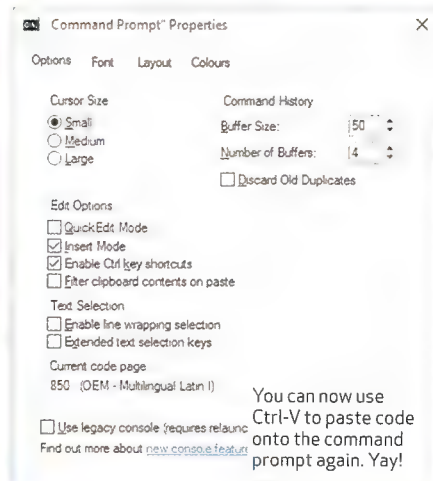
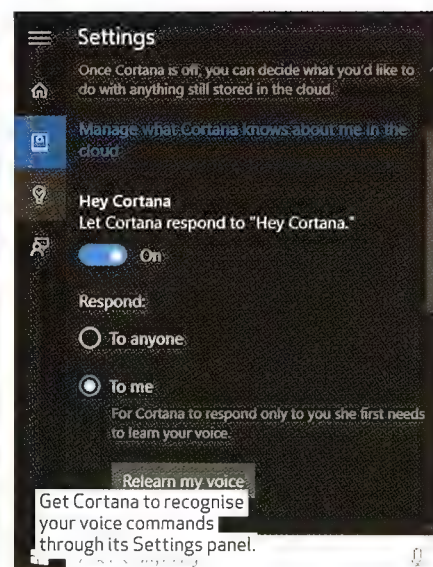
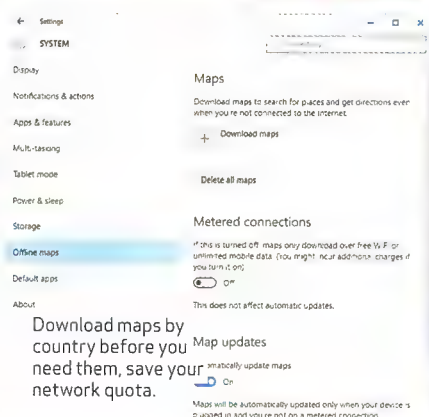
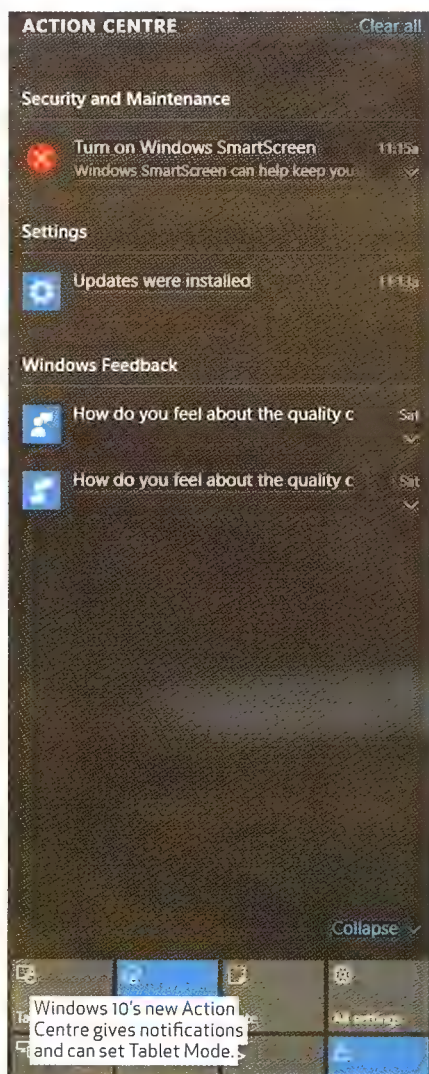
Windows has a new Task View feature – Windows Key-Tab, which also hides a '+ New desktop' icon bottom right. Yep, Windows 10 now supports virtual desktops. Click that icon to create a new virtual desktop or use the 'Windows Key-Ctrl-D' shortcut and use Windows Key-Tab to choose

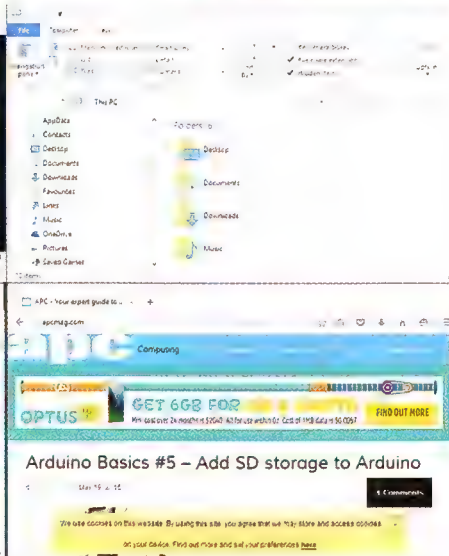
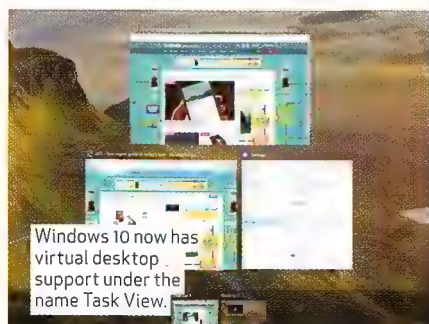
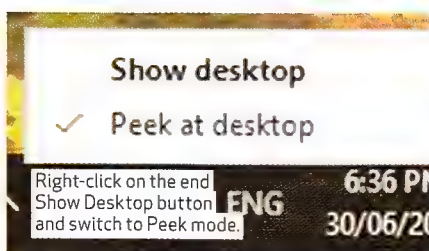
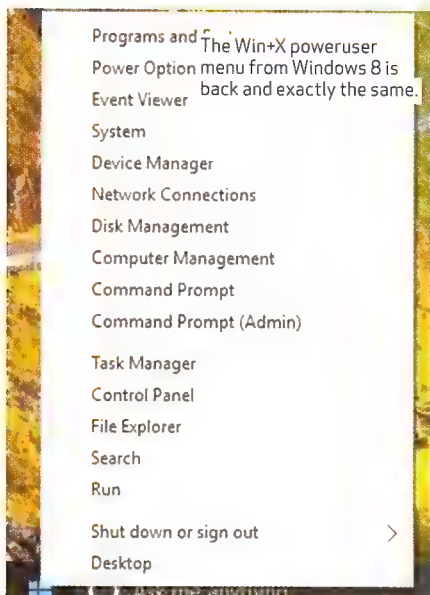
between desktops. Ideal if you don't or can't have a second monitor.

RESIZE THE START MENU

We've covered it elsewhere this month, but just in case you've missed it, the

new Start menu can be resized like any app, by just clicking and dragging the top or right edge of the Start panel. The top edge is continuously resizable, while the right edge collapses the tile panels into a single vertical column.





THE NEW ACTION CENTRE

Keep missing those 'here-gone' notifications in the system tray? Windows 10 has expanded this out to a new Action Centre panel, keeping track of notifications and when they were sent. Just click on the text bubble icon in the system tray and the panel flows out from the right-side. Use this to also switch between desktop and tablet modes.

USE CTRL-V ON COMMAND PROMPT

The new Command Prompt now also allows you to use Ctrl-C/Ctrl-V to copy and paste commands inside. But to get this happening, you need to right-click on the Command Prompt header, select Properties and at the bottom of the Options tab, tick off the 'Use legacy console' checkbox (it's on by default in Preview 10130). This should auto-check the 'Enable Ctrl key shortcuts'. Restart and you're away.

HAVE CORTANA ONLY RESPOND TO YOU

You can get Cortana to respond only to your voice. Click on the Cortana search bar, select Notebook from the left menu, choose Settings, scroll down and tick the box at 'Let Cortana respond to Hey Cortana'. Press the Learn My Voice button and speak the phrases to teach Cortana your voice. After that, it automatically sets the Respond option to 'To me' and now only responds to your voice.

CHOOSE RIGHT OR LEFT-SWIPE DELETE

Windows 10 is getting a new Mail app. Open it, click on the Settings (gearwheel) icon at the bottom-left and then Options from the pop-out Settings menu on the right-side. The Quick Actions option sets out how right and left swipe gestures work. Either way, you can choose to delete, move, mark as read or set/unset a flag.

OPEN FILE EXPLORER TO THIS PC

File Explorer replaces the Favourites folder view with 'Quick Access', but if you'd prefer to go straight to 'This PC' when the app is launched and see all your storage, click on the View tab, select Options and change 'Open File Explorer to:' setting to 'This PC'. Click the OK button and restart File Explorer to commit.

REMOVE CORTANA'S SEARCH BOX

Don't want the Cortana search assistant taking up so much taskbar space? Right-click on an empty part of the taskbar, select Cortana and choose 'Hidden' to change it to a pop-up. You can keep Cortana on the taskbar as a standard icon by choosing the 'Show Cortana icon' instead. You can also revert back to the search bar again using the same method.

LEARN NEW SNAP KEYBOARD SHORTCUTS

Windows 10 has a new Snap feature – it now supports a 2x2 grid. So learn these Windows Key+<Arrow> key shortcuts. Replace <Arrow> with 'left' to snap the current window to the left, 'right' to the right, 'Up' to the top and 'Down' to the bottom. Double-up commands to reach the quadrants, for example top-left is Windows Key+<Left>, then Windows Key+<Up>.

USE THE POWERUSER MENU

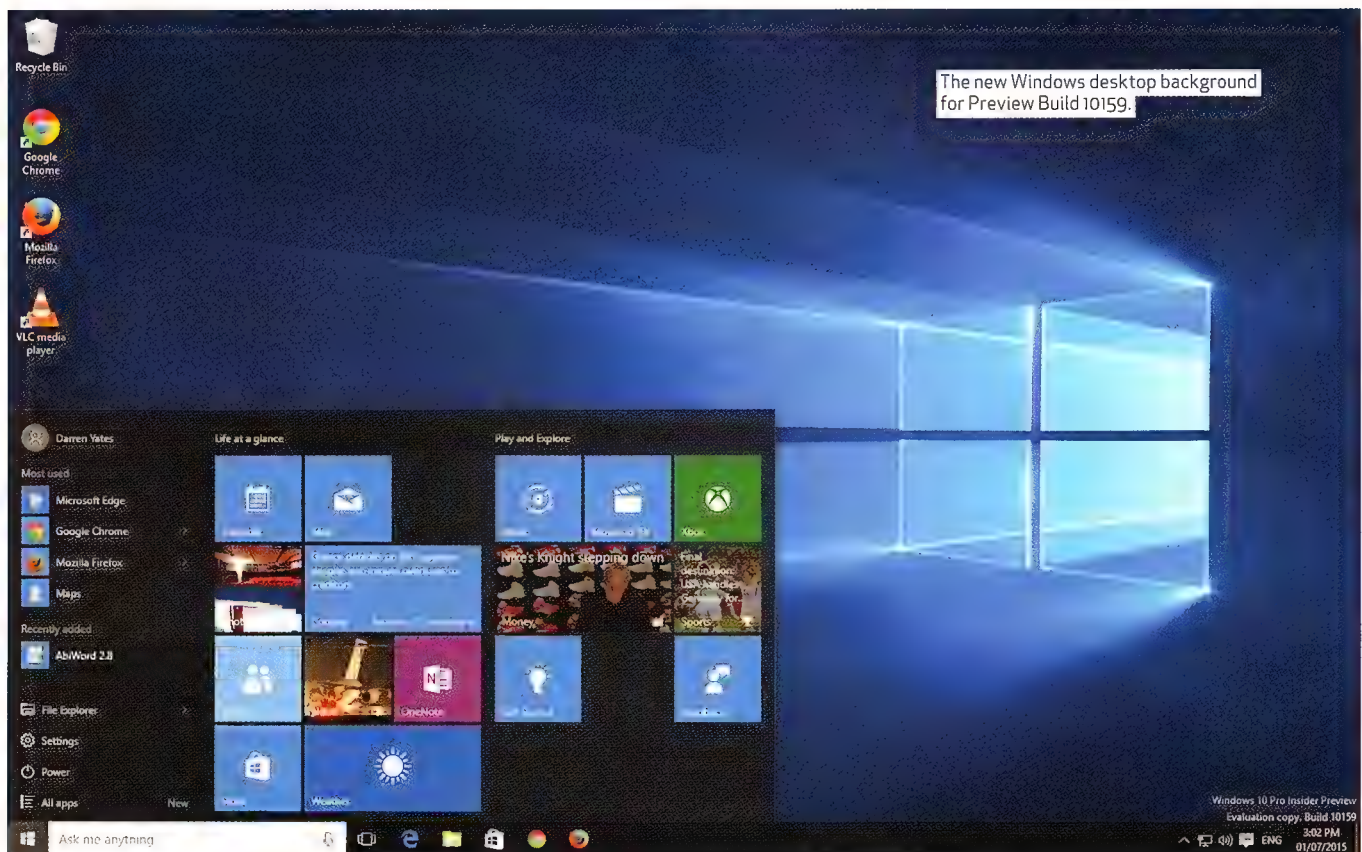
The new Start menu doesn't bring back Control Panel to the menu list, but you've still got the power user menu from Windows 8. Just right-click on the Start icon or type 'Windows key-X' to bring it up. In Build 10158, it's exactly the same as it is in Windows 8, so you shouldn't have trouble with it.

SAVE APPS TO EXTERNAL DRIVES

Using a Solid State Drive as your system drive and want to conserve space? Tell Windows to save future apps to other storage. Select 'Settings' > System > Storage', make sure your alternate drive is available and set 'New apps will save to' to your alternate drive. It should work nicely with Windows 10 tablets.

BACKUP AND RESTORE RETURNS

Microsoft killed it off in Windows 8, but the old Backup and Restore app from Windows 7 has made a return in Build 10158 of Windows 10 Preview and should make an ideal option for Windows 7 users to jump straight to Windows 10. You'll find it lurking in the Control Panel. ■



Windows 10: the review

IT'S LOADED WITH CHANGES, MANY IMPROVEMENTS, BUT STILL THE ODD FEATURE THAT MAKES US WINCE... PLUS SOME IMPORTANT UNANSWERED QUESTIONS.

DARREN YATES REVIEWS WINDOWS 10.

As we've noted elsewhere, Windows 10 has a lot to try and live up to, from Microsoft's 'Windows Everywhere' strategy to giving Windows 7 users reasons to come back after Windows 8. It has to appeal to consumers and business alike, which effectively means innovation and predictability in almost equal measure. It's a tall order – so how well has Microsoft done?

VERSION PRICING

The new Windows 10 OS will be available in three basic versions, two for general use – Windows 10 Home and Windows 10 Pro – plus Windows 10 Mobile for phones and smaller tablets. At time of writing, no local Australian pricing had been announced, however, Microsoft US had declared Home would sell for US\$119 while the Pro version would cost US\$199. If you decide to jump from Home to Pro, the upgrade will cost an extra US\$99. As we've already discussed, all three will be available as a free upgrade for genuinely-licensed non-Enterprise Windows 7 SP1, Windows 8.1 and Windows Phone 8.1 users, respectively.

There'll also be a number of other editions, including Windows 10 Enterprise (built on the Pro version), Windows 10 Education (built on Enterprise) and Windows 10 Mobile Enterprise (tinyurl.com/oedx95d).

THE NEW START MENU

As for how it works and performs, we'll start with the obvious first. Keeping in mind that we're working off the latest Windows 10 Preview Build 10159 we had available and not final-release code, we think the Start menu looks great, but has lost some of its configurability. For example, in earlier Preview builds, you could choose to add the Control Panel to the left-side Start menu list. But as Start's Settings controls have been progressively 'Modern'-ised, adding the Control Panel seems no longer an option.

Also, the 'Taskbar and Start Menu Properties' applet no longer has Start Menu options. And surprisingly, right-click on File Explorer in the Start list, select Properties and it launches the Control Panel's System applet – not something we would've picked.

Microsoft has been continuously tweaking the Start menu throughout

the Preview Builds process, so we'll be surprised if there aren't more changes before the final-release. However, the fact the Start icon no longer sends you out to the Modern UI galaxy is definitely the right move. Combined with new Tablet Mode, it puts choice back into the user's hands and that's exactly what you want.

MICROSOFT EDGE

The new web browser and its new lean Trident-esque render engine have definitely found a yard or two of pace and now more-or-less match the latest Firefox and Chrome releases on our testing. We can see the value of Web Notes, and as of Build 10158, it's now working on every web site we tried. It's a cool feature, although we'd like to have greater choice in where Web Notes are stored, rather than just the browser Favourites folder. As of 10159, a fair chunk of Edge's Settings panel, including F12 developer options, are still greyed out.

However, it's clear Edge has been dunked solidly in the 'Modern UI' bucket and will take some getting used to for those with Internet Explorer leanings. Otherwise, Internet Explorer

11 is still included in Windows 10, but since it's no longer the default browser, you have to go looking for it (Try 'Start > Windows Accessories').

CORTANA IMPROVING

Windows 10's new voice-recognition digital assistant from Windows Phone has been a bit up and down in the preview builds – good in 10130, slow and buggy in 10158 and back to good again in 10159. In this latest build, it's now much faster, whether you're asking it the time of day in Sydney, to 'tell me a joke' or to open an app. The configuration options are good, but right-clicking on the search bar no longer provides a quick-link to Settings (you now have to use the unintuitive Notebook/Settings menu one-two).

DIRECTX 12 GAMING

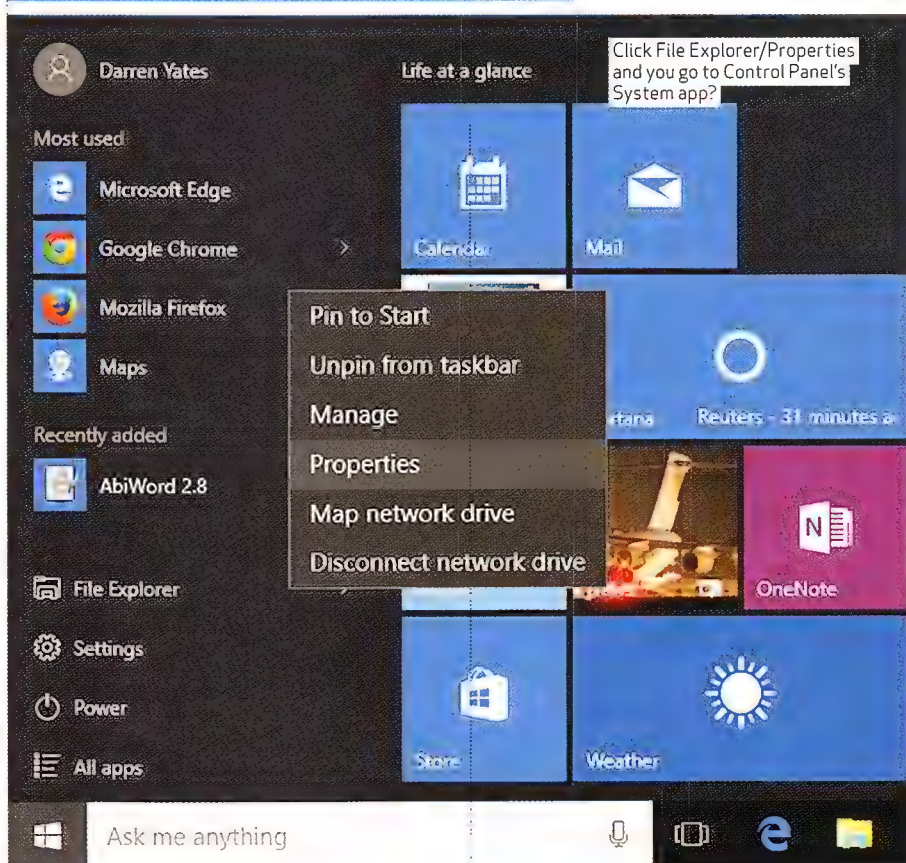
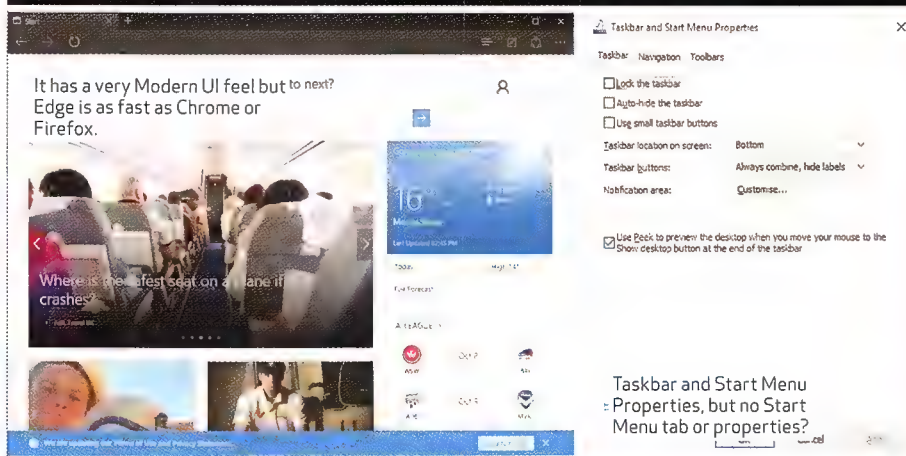
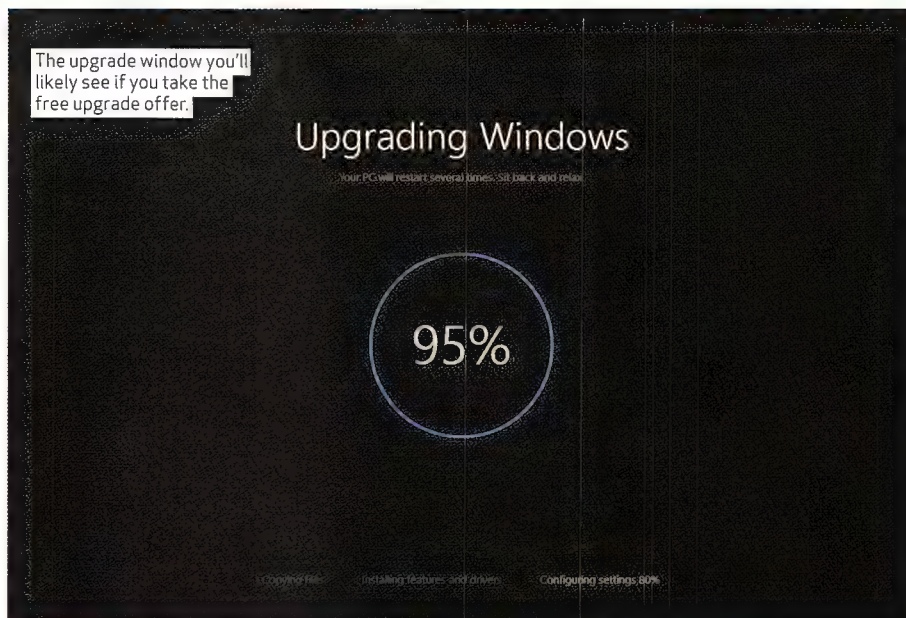
We're stuck with tech demo previews for now, but DirectX 12 is still shaping up as one of the most significant releases in years. The three killer features for us are better access to lower-level GPU coding, which in turn, is delivering better performance from the same silicon, plus more efficient coding leading to lower power consumption (and better battery life) and finally, 'Multiadapter' that enables discrete and integrated GPUs to work together. Some of the effects we've seen, like ray-traced shadows in recent Nvidia demos, look sensational. Like all other new DX releases, it'll likely take some time before we see DX12 delivering its full potential, as game developers pick their way through the new additions. But it's clear they now have lots of new toys in the cupboard to play with.

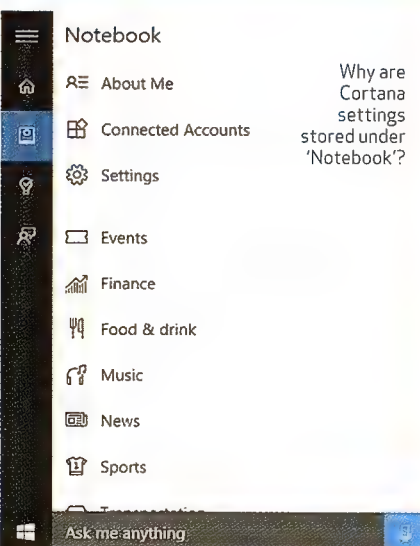
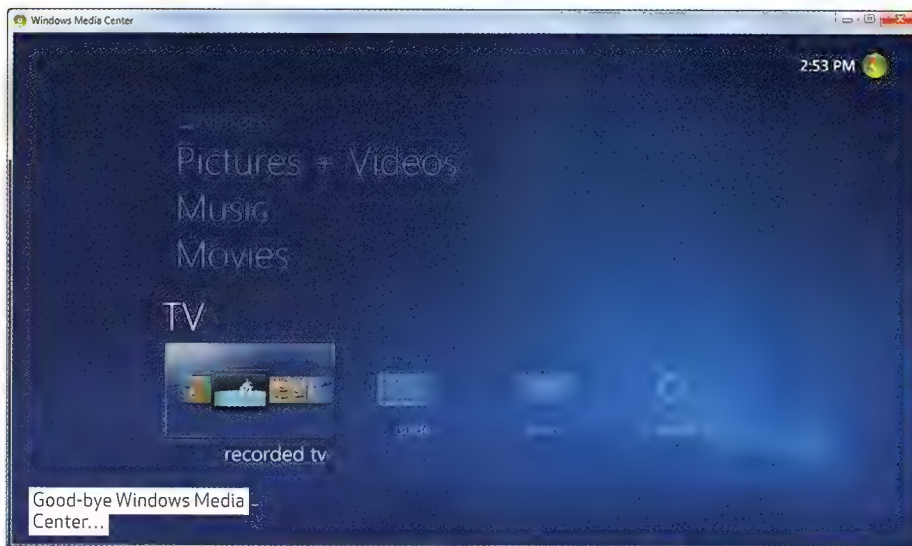
You'll need to grab an Nvidia Kepler (GeForce 600) or AMD Radeon 7000-grade GPU to gain full benefit (reportedly less on Xbox One), although Nvidia also says older Fermi-class GPUs will be supported later. But given we're not talking brand-new silicon here, that's still an excellent result, bringing the latest gaming capabilities to older systems.

WHAT YOU LOSE

When you're invited to a free upgrade of a new operating system, you're probably not expecting to lose functionality from your existing system, yet take up the free Windows 10 offer and that's exactly what you could get.

For starters, Microsoft has given Windows Media Center the axe for Windows 10 – in fact, Windows 10 doesn't even come with DVD movie playback capabilities. It also means if you're using your Windows 7 or 8 PC as a home theatre setup with Media Center and DVD movie playback – even if you've paid for the Pro pack in Windows 8 to get Media Center – upgrade and



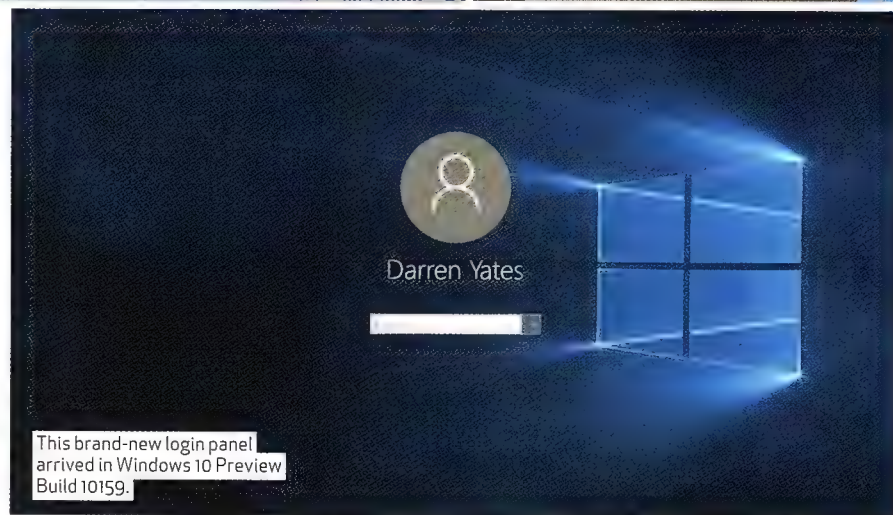


those features disappear. There are numerous free alternatives for Media Center – we suggest Kodi (kodi.tv) or MediaPortal (team-mediaportal.com) for starters – and DVD movie playback can be restored with VLC Media Player (videolan.org). At this stage, Microsoft has intimated it will provide a DVD playback option sometime after Windows 10 launches – most likely at a small cost. But for those who paid extra for Windows Media Center, it's hardly the best solution. However, it's probably a good lesson in the long-term wisdom of finding your own third-party software solutions rather than relying on in-OS bundled apps.

COMPULSORY WINDOWS UPDATES?

There's something else making us wince and it has to do with rumoured plans for Windows Update. For those in the Insider Program, all updates are compulsory, sensibly for a beta program. However, there is growing speculation Windows 10 Home users – and possibly Pro users – will also have to cop all updates, whether they like it or not.

What's partially responsible for the angst is Microsoft's Windows 10 specifications page, which, under 'feature deprecation', lists 'Windows 10 Home users will have updates from Windows Update automatically available' (tinyurl.com/pq19fs2). It goes without saying every Windows 10 user will have Windows Updates available, but 'automatically available'? And why only Windows 10 Home users? And why list it under 'feature deprecation'? The page caveats the OS specs as for a 'pre-release' version of Windows, but the Windows 10 Pro Preview also has compulsory updates, so singling out Home doesn't make sense. However, the answer might have come in a Microsoft blog post intended for enterprise customers (tinyurl.com/nzakzne). Here, Microsoft's Jim Alkove says to enterprise buyers that they'll be able to



receive feature updates 'after their quality and application compatibility has been assessed in the consumer market'. Now apart from sounding like consumers are to become Microsoft 'bug-bait', is that assessment possible, thanks to those compulsory updates? If it's all true, it's quite staggering and you can't help wanting to brace for impact. Many of us have Windows updates on 'automatic', sure, but seemingly having 'Hobson's choice' in joining the Microsoft testing ground doesn't exactly give me the warm-and-fuzzies.

OUR RECOMMENDATION

While the free upgrade offer is tempting, here's why we'll hold off for a month or so. First, once you upgrade, if or how you can revert back to your old OS isn't certain. The Windows 10 Preview includes a rollback feature to recover your old OS from the point of Preview installation (tinyurl.com/pw7rfqt), but without certainty of final-release code, there are no guarantees.

Next, Windows 10 is such a monumental shift in core design, it's hard to believe every app you own will install or continue to run perfectly on this new OS. We'd certainly hold off

switching over production or mission-critical systems until this new OS has been in the wild for a bit and had time for the paint to dry.

Then there's device drivers – the extent to which device support is carried over from previous Windows releases is unknown. Depending on the level of changes within the Windows core, it's possible that some legacy peripheral devices might be no longer supported. There's also the issue of device driver availability for current-generation peripherals. You should check that Windows 10 drivers exist for your gear before jumping head-long into the upgrade nettles.

And finally, there's all the 'how-do-you-do' with Windows Updates, something we need Microsoft to explain much more clearly.

In fact, we recommend you first run the Preview OS either on spare kit or alternatively, as a virtual machine in something like VMware Player 7.1.2, get a feel for it, install all your must-have software and make sure it all works before you commit. That's our plan.

Don't get us wrong – it looks great and has some killer new tech, but give it time for the gremlins to be rounded up before you sign on the dotted line. ■

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Stream machines

In-home game streaming has truly arrived, but it's a Wild West of new tech. So which options work best? Jeremy Laird

Streaming games from your PC to other devices. It's a crazy idea, right? It is if you really think about the nuts and bolts.

Start with a control input from your client streaming device, whatever that may be. A precision flick of the mouse in reaction to gunfire behind you. That kind of thing. The signal has to be processed by the client box and then sent over your network to the host PC. That PC then processes the input and updates the game state by rendering new 3D frames, calculating some AI, number crunching the audio and everything else that goes into a modern game engine.

The result of all that is thrown together, encoded into a video stream

and bounced back over your network.

The client box then decodes this stream and pumps it out to a display, which itself has image-processing hardware that inevitably adds a little delay.

All this has to happen fast enough to be pretty much transparent to you, the end user, with your own wetware doing more than a little processing itself. Move mouse or press controller button, see the screen respond. It has to feel instant. That the latest in-home game-streaming solutions come tantalisingly close to achieving just that is an incredible technical achievement.

How the hell it's all achieved in a passage of time measured in just tens of milliseconds we can barely

comprehend. But it is and no doubt the whole process will only get faster, better and more responsive.

In-home game streaming, then, is a reality. It's not yet ideal for every game or even every gamer. But having a single powerful PC pumping games to multiple devices around your house is one hell of an idea. And there are now a number of ways to do just that. What's really exciting is that you can give it a try for not a lot of money.

Welcome, then, to our guide to the state of streaming on the PC, with a heavy emphasis on gaming. That includes everything from insight into the competing streaming platforms to looking at the best streaming boxes available. Let's go.



Is cloud gaming dead? Maybe, but in-home streaming is taking off.



Trevor doesn't like lag. It makes Trevor angry. You don't want to make Trevor angry, do you?

First up, let's set some parameters. Streaming means different things to different folks. For some, it can simply mean watching web video.

If that's all you care about, then cheap and cheerful gadgets like Google's Chromecast (or an Amazon Firestick) will get you over the line. Conceptually, those things are streaming simpletons, mere dongles you plug into your HDTV to enable web content on an otherwise dumb device.

The next step up is a fuller-featured streaming box, such as the Roku, which enables a broader range of functionality and apps. It gives you more options and access to more content. But we're talking about the same basic functionality, namely video and music playback.

We, however, want more. Much more. All that media playback stuff is great. But there's a killer streaming app that sets the bar much higher. That's right, it's gaming. Immediately, adding games into the mix means far higher performance expectations and hardware requirements. We're dealing with much more complex streaming devices and services. It would also be pretty nice if our streaming box was a half-decent computing device in its own right. And we want it all for cheap compared to a full-power PC. Otherwise, what's the point? Just buy another PC.

Is that a lot to ask? Maybe. But the hardware guys keep telling us what a great job they're doing in terms of squeezing proper computing down into ever more mini packages, both literally and in terms of price. So why not?

Anyway, we all have a rough idea of what goes into basic media streaming. So, let's tick that off as a known known and address the known unknown that is game streaming. We know we want to do it, but maybe don't realise what goes into it. What exactly does game streaming mean, what do you need to get it done and what are the competing technologies on offer?

KEEPING IT LOCAL

We'll start by saying we're not talking

Classic Conundrum: AMD or Nvidia?

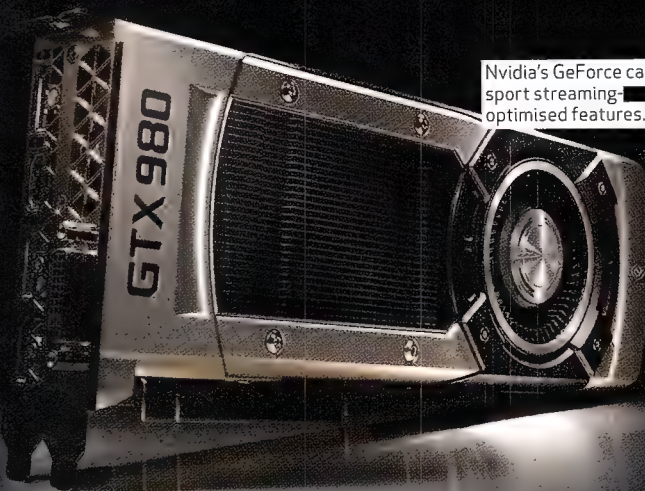
It's the war that never ends: Nvidia versus AMD. Inevitably, the latest battle involves game streaming

Just like other skirmishes between the two big beasts of the gaming graphics world, streaming finds Nvidia investing in proprietary tech while AMD is playing a more open-source path. For Nvidia, that means making its Shield portable console and Shield tablet the hook on which it hangs game streaming. Add in the GeForce Experience app running on your PC, along with optimisations in Nvidia graphics silicon to improve streaming performance, and you have a total solution known as Nvidia GameStream.

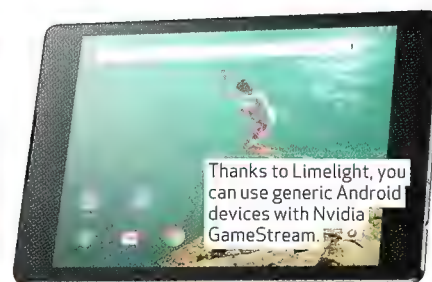
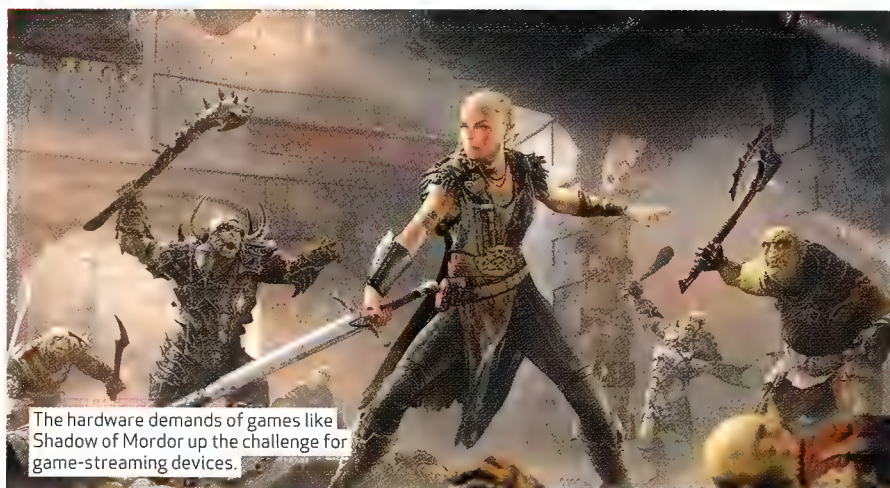
It even includes support for remote streaming of your games from your PC over the internet as well as features like ShadowPlay, the latter involving optimisations for the capture and conversion of games into video streams. Nvidia argues that restricting its streaming tech to a combination of its own graphics card and a Shield device allows for a much more polished performance. And that means less of the biggest killjoy — latency.

On the other hand, Nvidia has no control over your home network, which is clearly critical. Likewise, flexibility when it comes to both graphics cards in your PC and the streaming device itself is obviously desirable.

As for AMD, it doesn't have a complete solution like Nvidia's. Its Gaming Evolved platform can stream for remote viewing, but not for gameplay. Instead, you'll be using Valve's In-Home Streaming tech that's built into the Steam platform. In theory, it's just like Nvidia GameStream. Indeed, Steam is Nvidia GameStream-aware and you'll probably be running in Steam Big Picture mode on your HDTV whichever way you go. So, the basic look and feel will seem the same. But in our experience, Nvidia's end-to-end streaming tech is both better when it comes to lag and also simply more reliable. You get fewer problems with games simply failing to load with GameStream than you do with Valve's In-Home Streaming.



Nvidia's GeForce cards sport streaming-optimised features.



here about cloud-based game streaming services delivered to anything with a web browser. What with the OnLive cloud gaming service finally and permanently shutting down earlier this year, the future looks shaky for cloud gaming. Instead, we're concerned with in-home streaming from your main PC gaming rig to another device or display, typically but not necessarily, the HDTV in your living room.

That kind of streaming places far more demands on hardware and software than mere media streaming. It's also a relatively new technology, making for a veritable Wild West of competing technologies and standards, sometimes complementary, but often antagonistic. That's almost inevitable when the players involved, companies like Nvidia and Valve, are competing to dominate PC game streaming.

The default option is Valve's In-Home Streaming tech that works with basically any graphics card, regardless of branding. If your 3D board is good for gaming on your PC, it's theoretically good enough for in-home streaming courtesy of Valve. The main alternative is Nvidia's GeForce Experience plus Shield GameStream

platform. But that's a far less flexible option. There's also a third option in the form of the US\$100 NZXT Doko, which doesn't just take graphics card compatibility out of the equation, but guarantees universal game support, too. You'll have to import it, though.

Whatever you go for, however, you're into a whole new class of device compared to mere media streaming. That's largely a consequence of the rigours of game streaming. For video playback, it doesn't matter a great deal if there's a bit of lag between a source device feeding the content and the screen on which you're watching it. So long as the streaming device can decode the video without dropping frames, you're basically golden.

Not so for game streaming. OK, you may not need the latest multi-core CPU or thousands of graphics shaders in a streaming box. Actually, that's the very point of game streaming, to enable you to pump gaming action around the house from a single, powerful PC rather than having a pricey gaming rig in every room. But you do need something quick and responsive that can decode a video stream without introducing the great bane of game streaming — you need something

powerful enough to minimise lag. You also want a platform that just works, something with broad compatibility with all your games. The question is, how much processing power is enough? While we're at it, how much lag is too much lag? And what is the best game-streaming technology or platform on offer?

Unfortunately, there are no simple answers. There are no minimum specs to aim for, nor any millisecond metric we can point at and say this is what you should aim for in terms of lag. In our experience, once you get up to around 60ms or so, most people will notice the lag.

Of course plenty depends on the kind of game you're playing and your subjective sensitivities to lag. Nailing the competition in a hair-trigger shooter can mean that every millisecond counts, making for pretty much the worst candidate for game streaming. A nice-looking strategy game, on the other hand, will be much more tolerant of a little lag. Conventional third-person, single-player console ports fall somewhere in between. Either way, if you haven't experienced game streaming before, we think you'll be pleasantly surprised at just how responsive the technology has become.

There's one other request we're making of our streaming boxes. We'd ideally like them to be serviceable, usable computers in their own right. Allowances have to be made for the

Steam hardware that's been announced

STEAM LINK

You'll be able to use this little device to stream games from your desktop PC to your HDTV at 1080p/60fps.



ZOTAC SN970

Out in November in the US, Zotac's SN970 will be home to a mobile Core i3 and a GTX 970M GPU.



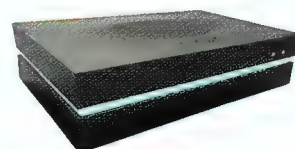
ALIENWARE ALPHA

Alienware's box comes with a wireless Xbox 360 controller and plenty of upgradeable parts.



IBUYPOWER SBX

This US-exclusive includes an Athlon X4 840 CPU and a Radeon R7 250X GPU.



fact that these are very small and, compared to a full-fat gaming rig, cheap machines. And yet we're still talking about a price measured in many hundreds, at least in most cases. It's a significant investment to make, meaning a little standalone functionality would be nice.

POWER PLAYERS

So, we're not expecting these micro machines to play games themselves. But we are interested in what they're like as computing devices in their own right. In other words, everything from simple stuff like browsing the web (which can actually be quite resource-intensive with the latest sexed-up web interfaces) and video playback, to a little light content creation on the side. Can they cope?

This immediately raises all kinds of tricky questions. How much computing power is just enough? Do you need a full Windows operating system on your streaming box? Will a mobile operating system such as Android get the job done? Perhaps even some freebie open-source Linux action on a super-cheap ARM chip?

Then there's the minor matter of whether you're looking for a permanent installation alongside your TV, or something more flexible, something more portable. There are an awful lot of options. Luckily, we've gathered together a group of devices this month that should provide pretty much all the answers to those questions.

We've got the money-no-object solution in the form of small form factor PCs with full-on Core processors. In theory, the likes of the Intel NUC and MSI Wind should deliver something nearing a compromise-free and full-feature Windows computing experience, together with the fastest, most responsive streaming experience.

Then there's the Intel Atom option which retains the benefits of a full Windows OS and x86 compatibility

Steam or Stream?

Valve's Steam Box: Still coming, but what's the point?

Valve's Steam boxes. Whatever happened to them? A bold vision for the future of PC gaming, the Steam box was supposed to combine a number of new initiatives from Valve, including the Linux-based Steam OS and, indeed, game streaming.

But here we are in mid-2015 and the Steam box proper hasn't really arrived. We're told they're still coming. But should you even care? Arguably, the Steam box is a solution to a problem that doesn't exist.

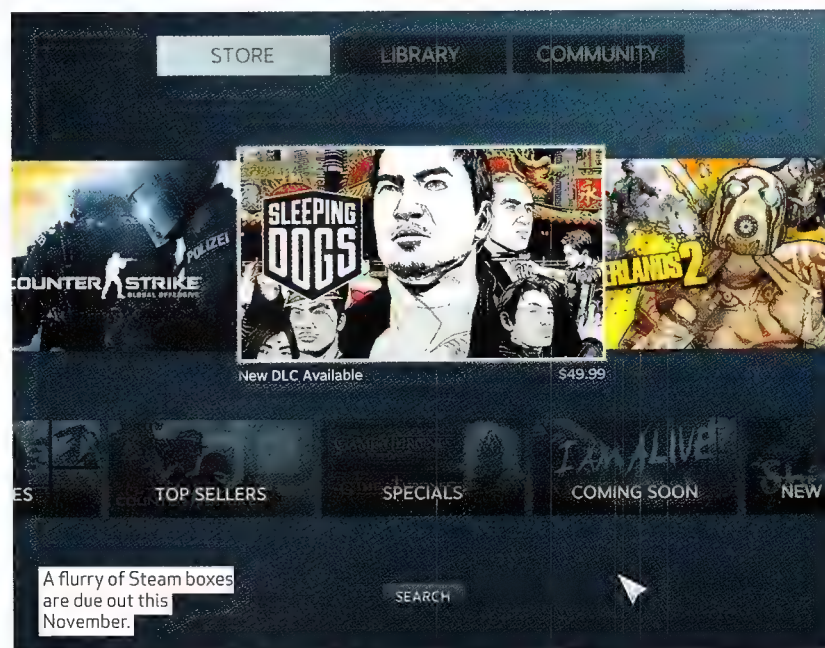
Valve's Gabe Newell has been quoted bad-mouthing Microsoft, the company he himself used to work for, and its Windows operating system. We're talking about the whole "Windows 8 is a catastrophe" thing.

The temptation is to see the Steam box and Steam OS as something of a personal Newell vendetta against

Microsoft. Whether there's any truth in that probably doesn't matter. What does matter is that turning Linux into a proper primary operating system for gaming is a huge task in terms of software and particularly graphics driver support. It's so big that even Valve, the biggest beast in PC gaming software, can't simply click its fingers and see it happen.

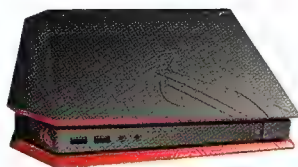
In that context, Steam boxes and the Steam OS make more sense as streaming tech. But then you also have to ask what's wrong with simply running Steam on Windows? The cost of Windows?

That's not to say Steam OS and indeed Linux itself isn't welcome, but it's more part of the mix rather than an obvious no-brainer.



ASUS GR8S

ASUS's tiny Steam machine starts off with an i5 CPU and 4GB of DDR3 memory.



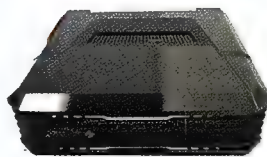
ORIGIN OMEGA

It may look like a hi-fi, but this is very much high-end. Expect a Core i7, GTX 980 and up to 14TB of storage.



SYBER GAMING VAPOR

There'll be three versions of this Steam Machine available in the US..



STEAM CONTROLLER

Imagine an extremely customisable Xbox 360 controller with touchpads.





NZXT's Doko isn't exactly dumb, but it's also not a standalone device.



Intel's NUC is a pricey but powerful streaming option.

with a bazillion apps, plus access to a proper desktop web browsing experience. Atom-based streaming boxes will cost you a lot less money. They can also be far smaller and run completely silently. But at what cost to performance?

You do, of course, have the option of stepping outside the Wintel box. Nvidia's Shield platform is arguably what really got the whole in-home streaming revolution rolling. Nvidia, as ever, has put a lot of work into polishing its GameStream proposition, with a particular emphasis on reducing gaming lag.

But also in true Nvidia tradition, it's come up with a thoroughly proprietary setup that requires end-to-end Nvidia hardware. You'll need an Nvidia graphics card in your PC and you'll need a Shield console or tablet plugged into your HDTV or whatever display it is you plan to use. You can't even use a device like, say, a Google Nexus 9, despite it sporting exactly the same Nvidia Tegra K1 processor and also running Android. Nope, sorry folks, it has to be a Shield device. (And none of these are technically available in Australia yet – although you can find some local retailers selling imports.)

SEEING THE LIMELIGHT

Or does it? Actually, it doesn't, but no thanks to Nvidia. Instead, give it up for Limelight, an open-source game streaming app that plugs right into Nvidia's GeForce Experience interface and allows you to access all its game-

streaming goodness, provided you're running a GeForce graphics card.

Even better, Limelight is multi-platform. Versions for Windows, Android and Linux are available, opening up a whole new world of streaming options, including arguably the most intriguing of all, the tantalising prospect of turning the puny Raspberry Pi 2 into a powerful gaming PC. Remarkable, given the low price.

In practice, we've found the Windows version of Limelight to be patchy. The Linux variant, on the other hand, isn't exactly user friendly. It needs a fair bit of setting up and command line expertise, by Windows standards at least. But then it was ever thus for Linux, wasn't it. Limelight for Android is probably the slickest and easiest to use of all. That's handy because it opens up a whole range of options. If you already have a decent Android tablet, for instance, you should be able to get game streaming running without spending a single penny.

Getting back to that Raspberry Pi, it's seen here in its revised second edition. In many ways, it's hopelessly outgunned, even after a hardware upgrade to a quad-core processor and a gig of RAM. But then it was always going to be. The Pi appears here really to satisfy our curiosity. Is it truly a realistic option for game streaming? Or is it just a toy, albeit a powerful one, for learning about computing?

The final joker in our streaming pack is the NZXT Doko. It's a bit of a rule breaker due to not really being a computer in its own right. It merely mirrors the output of your PC to another display and has essentially no independent functionality. Disconnect your PC and the Doko drops dead.

The thing is, on paper it does that mirroring in such a clever, full-featured manner, it has us wondering whether all these specialised game streaming interfaces have got it wrong. Just stream your whole PC, USB ports and all, and forget about game compatibility and the need for specific hardware. Sounds like a no-brainer, eh? These are not the only streaming boxes out there, of course. But they do

cover all the key options. At one end of the spectrum, you've got the relatively big money boxes with Intel Core processors. At the other end, it's the preposterously parsimonious Raspberry Pi 2. In between, you've got cheap Atom boxes and tablets.

Of course, once you've picked your stream machine – and in some cases, before – you'll need to take a view on wired versus wireless networking. In an age where wireless comms are assimilating almost everything, game streaming is arguably the final frontier of fixed wires.

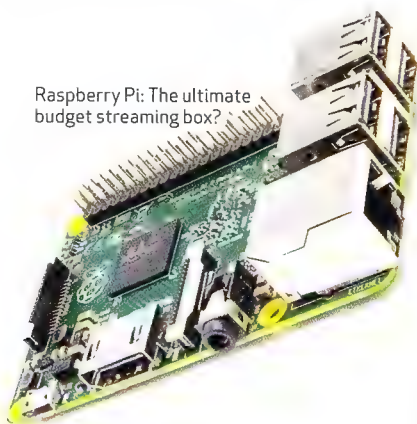
STILL WIRED

No other app you're likely to use is so sensitive to both bandwidth or latency. In theory, the latest Wi-Fi tech has easily enough bandwidth for what amounts to a glorified HD video stream with some control signalling slapped on top. But unlike conventional video streaming with its service-smoothing buffering, even the slightest connection glitch can be catastrophic for game streaming. Buffering is not an option.

All of which means that while wireless streaming can and does work, you need to be realistic about the limitations. Room-to-room streaming can be marginal, for instance. If you're really serious about getting the highest quality streaming experience, we strongly recommend reacquainting yourself with Ethernet. That's particularly true if you're aiming for the current gold standard in game streaming, which is 1080p at 60fps. That's a fair old bit of bandwidth, if you want to keep the image quality tip-top.

Oh, and for the record, our experience with powerline networking is that it's not a great fit with game streaming. For whatever reason, be it protocol overheads or background noise, it tends to introduce too much lag. And that, folks, is the background to PC-based game streaming. ■

Raspberry Pi: The ultimate budget streaming box?



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how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

MAC

REINSTALLING OS X WITHOUT THE DVD

I'm trying to install Yosemite on a MacBook Pro with a new, blank hard drive (the old one died and was replaced). I have a copy of Mountain Lion on a DVD, but I don't seem to be able to install it. If I go to Apple's web site on my Windows PC, there's no Mavericks download button. Am I marooned without an OS?

James Ifans

You won't see the download button unless you're viewing it on a Mac. You need to get at least Snow Leopard installed in order to be able to download the Yosemite Upgrade. Since your Mountain Lion install DVD isn't working, you have two options: if you know someone else with at least Lion installed, you could use DiskMaker X (diskmakerx.com) on their Mac to create a bootable install disk; alternatively, you can call Apple customer support (1300 321 456) and give them the serial number of your MacBook. If you ask nicely, they should agree to send you a DVD for whatever version of OS X was originally installed on your MacBook. You can use that to bootstrap yourself back up to Mavericks.

Luis Villazon

MAC

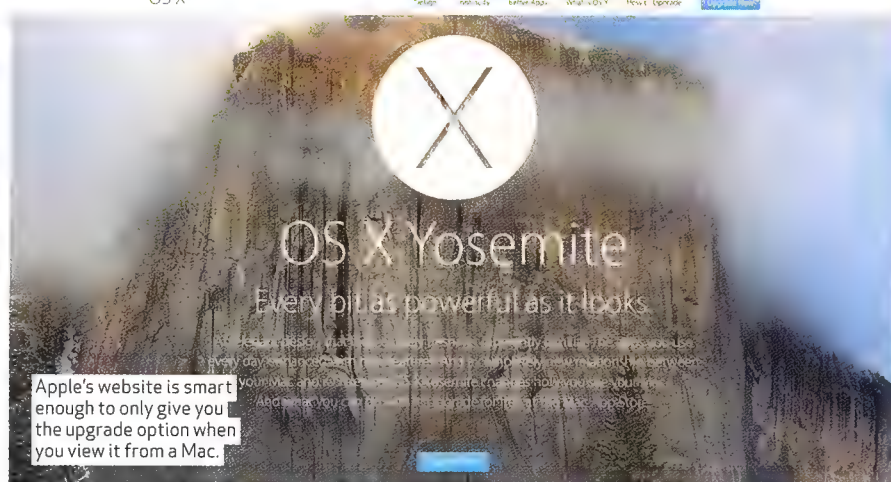
A BETTER WAY TO GO FULL SCREEN

Is there a way to run an application fullscreen on a Mac but still have the Dock showing? I don't like the autohide behaviour of the Dock so I normally have this turned off, but when I make an app fullscreen, it covers the Dock!

Bill Poole

Even if you have autohide turned off, the Dock will still slide into view in Fullscreen mode when you move your mouse to the bottom of the screen, much the same way the menu bar does. You can size a window to cover everything except the menu and Dock quite easily, by just dragging the corners. Apps won't resize to cover the Dock, although they can be moved behind it. Once you've sized an app manually, that size will be remembered the next time you open it. If you want your windows to snap

OS X



automatically, you can use BetterSnapTool (\$2.49, Mac App Store).

Luis Villazon

HARDWARE

SHARING MONITORS BETWEEN PC AND MAC

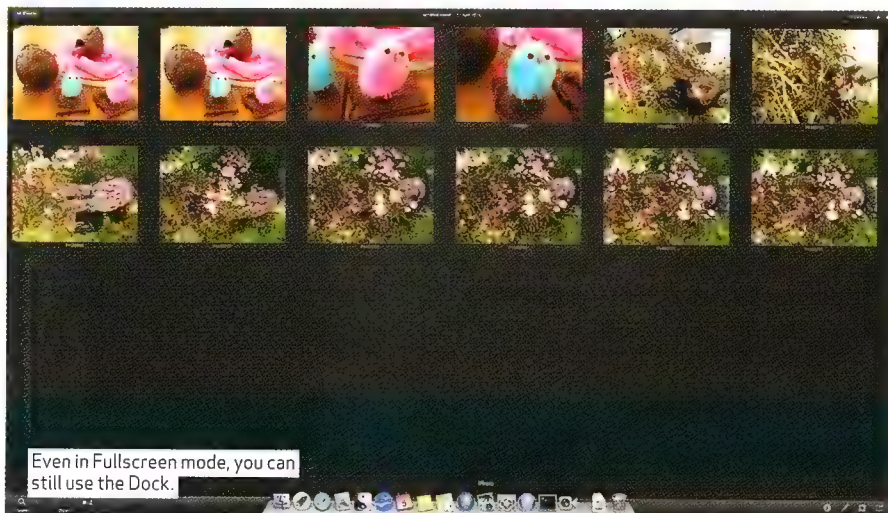
I have two computers and two monitors — a Mac Pro with a 27-inch Dell monitor connected using DisplayPort, and a Windows 8 PC with a monitor (also a Dell), that's shared between both the PC and the Mac Pro (over DVI on the PC). If I'm using the PC and then unplug the monitor and connect it to the Mac Pro, the Mac recognises the new display, but the screen stays black. After a few seconds the

monitor goes into standby. Is there any way to hot-swap these monitors?

Steve Byron

OS X sends a query to the monitor through the video cable when the Mac first boots or wakes from sleep, when you plug in the Mac end of the video cable, and when you hold ⌘ down in Display Preferences and click the Detect Displays button.

If the monitor doesn't answer with its display ID at any of these points, the Mac will conclude that there isn't anything at the other end of the cable and will stop sending video data through it. And the monitor in turn,





OS X's 'Detect Displays' button can force a stubborn monitor to notice you.

will drop to standby as soon as it goes a few seconds without a video signal.

It may be that your monitor isn't responding because it's only listening to the PC through the DVI port at the time and doesn't switch over immediately. You could try using the Detect Displays button on the Mac to send a few extra ID queries down the cable and see if the monitor catches any of them. If that doesn't work, try cycling the power on the monitor first, before you plug it into the Mac. Even if this works, it's a little inconvenient to have to turn the monitor off and on again every time you switch computers.

However there is a glimmer of hope. There are a few monitor detection bugs in Mavericks 10.9.4 that Apple is aware of. By the time you read this, 10.9.5 will be out, not to mention the possibility of 10.10, Yosemite. There is a good chance that Apple may have fixed this issue in the display driver by then, allowing better hot swapping detection.

Luis Villazon

HARDWARE

OPTICAL DELAYS

I upgraded my ASUS Z77 WS gaming computer to an ASUS Z87 WS MOB and Devil's Canyon CPU. After the upgrade I was getting long boot times with a Samsung 850 SSD boot drive. All drivers, BIOS, and Windows 7 were up to date. I systematically removed the USB devices to see if they were causing the problem, but it persisted. I also checked Microsoft and they had a software update but that didn't help. I had two DVD/CD internal drives installed and when I went to load up a DVD it didn't work. I removed the drive and bingo, boot time dropped to 15 to 20 seconds. Could the BIOS searching for this drive be the cause? Side note: the ASUS Z87 WS makes for a great gaming board, with two 12v 8-pin CPU sockets and one 6-pin socket on the mobo to provide extra power for overlocks and multiple graphics cards. Has APC ever used a workstation board for a gaming computer?

Ron Apra

It sounds like you practiced excellent troubleshooting, Ron. As we've learned



It's uncommon — but not impossible — for optical drives to cause boot problems.

over the years, trying to "fix" issues when the hardware is faulty is an exercise in frustration. As far as your situation goes, yes, the POST process can hang when it finds faulty hardware. Though we've seen it in the past with optical drives, we've mostly experienced it with hard drives, and lately, SSDs. The system will poll each device on boot, and will wait for a response before either showing an error or moving on. In general, whenever your system is hanging during the boot process, it's hardware-related. As an aside, we'd test to make sure the drive is really dead before tossing it. Either swap the SATA port it's using or try a different cable. Regarding your side note, yes we have used workstation boards for gaming, and you're right, they're excellent. In fact, if you're inclined to run multiple GPUs they're the best, as they provide more bandwidth than consumer-based motherboards. However, you'll need to run at least three cards before you start seeing a difference. The rest of the differences, such as support for higher core-count GPUs and RAM, are just for bragging rights though, and won't make a difference in games.

APC team

HARDWARE

MASSIVE TOWER NEEDED

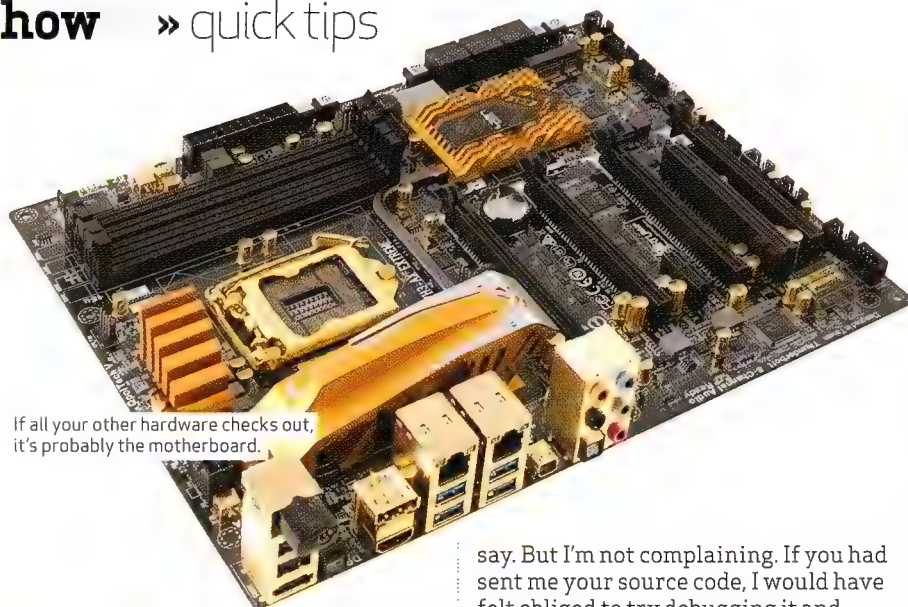
I'm running an old Intel Core i7-920 Nehalem CPU in a Lian Li V1110 case with nine hard drives, two Blu-ray drives and an SSD as a media server, movie-ripping station, and occasional gaming box. I've been waiting for the Haswell-E to drop, but having read APC's reviews I'm quite worried about CPU heat. In my current rig, I'm using a Thermalright Ultra 120 cooler, and my rig will occasionally reboot due to the heat. I love that my Lian Li case can accommodate many HDDs and is soundproofed, but it won't accommodate a large water cooler such as the Corsair H100 or H110. If I want to keep my case, but upgrade the motherboard, CPU, and RAM, what is the best cooling solution? Alternatively, is there a roomy case that can accommodate lots of drives, is quiet, and has room to fit a large water cooler?

Charles K.

Good news, Charles, there are several cases that meet your demands for hardcore storage and cooling. We know the Cooler Master Cosmos II and the Corsair 900D will both hold all that storage and a fat radiator, or at least a closed-loop liquid cooler like the NZXT Kraken X61 or the Corsair H100i. We've had both in the lab and can attest to their ability to swallow hardware, though for our money the Corsair 900D gets the nod. The 900D can hold nine hard drives, two power supplies, and a 360mm radiator, so throwing in a Corsair H100i would be like seeing if we could eat a single hot pocket. As far as quiet goes, you have to be able to strike a balance between good airflow and usable temperatures. Insulated cases are great for noise but not the best for keeping temperatures down. For what it's worth, we built a system using the Corsair 900D that had over 17 case fans (of the Scythe Gentle Typhoon variety) and it only emitted a gentle hum even under load. It was entirely water-cooled though. In our experience, the GPUs are the noisiest components in a PC, so if you can keep those quiet and use good case fans you'll be well on your way.

APC team





If all your other hardware checks out, it's probably the motherboard.

HARDWARE

OUT OF RETIREMENT

I've a home-brew PC that's been sitting unused for about 12 to 18 months. It was working fine when last used but upon starting it up it runs in super slo-mo. I reseated the RAM and videocard and ended up swapping out the VelociRaptor primary hard drive for an extra SSD I had, but it didn't help. I then tried reinstalling Windows, which took days. Installation of the video card driver also took days and the motherboard driver setup would not even run as it kept timing out. Any ideas?
Rob S.

It's best to go component by component. First just see if it will POST quickly with a single stick of RAM and nothing else, aside from the CPU. Then add the GPU, then a hard drive, and so on. And for each component, see if you can test them in another PC. If you can't isolate an individual piece of hardware it's very likely the motherboard itself. Our advice is to buy a new one from a place with a generous return policy, and try it out.

APC team

WINDOWS

WILL YOU DO MY HOMEWORK FOR ME?

I am studying C++ at college. My program needs to run as admin, so I have added to the program permissions elevation manifest file, like we were shown in class. But when I run my executable, Windows crashes and my source code isn't saved. What am I doing wrong?
Pravin Sindar

The most likely thing is that you haven't created the permissions manifest file like you were shown in class, and have instead introduced an error that is crashing your development IDE. But it's also possible that there's nothing wrong with your permissions manifest and it's a different bug in your program itself that is causing the crash. Without seeing your source code, it's difficult to

say. But I'm not complaining. If you had sent me your source code, I would have felt obliged to try debugging it and debugging other people's code is a wretched business. Instead, let me give you some general advice. In programming, most people try to fly before they can walk. If you've been shown how to elevate the permissions of your executable, try replicating the class example exactly and get it to work before you add any of your own code. Or try the example at tinyurl.com/d8seqm7. Once that works, delete your program and write it again from memory. For completely unfathomable, Windows-halting bugs like this, starting again is a good way to create the program or routine that you meant to write. That's often much quicker than trying to see the tiny discrepancy in the program you actually did write.

Luis Villazon

NETWORKING

I CAN ONLY LOG IN OVER WI-FI

My laptop running Windows 7 Ultimate won't let me log in to my user account when I plug the network cable in. If I unplug the network connection, it lets me log in but then I am restricted to Wi-Fi speeds for file transfers. I have tried creating new user accounts but they behave exactly the same. Is this a bug in Windows or is it my router?

Kieron Parry

The quick fix... It sounds as though Windows thinks you are part of a network domain. If you look at System (click 'Start', right-click 'Computer' and click 'Properties'), you'll see any domain under 'Computer name, domain, and workgroup settings'. If this domain business is news to you, click 'Advanced System Settings' on the System Information dialog, then the 'Computer Name' tab. You can then change yourself from a domain to a workgroup, which should resolve the weirdness.

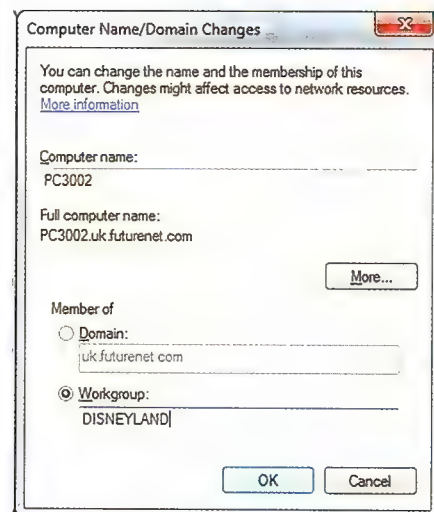
The boring background... Network domains are normally used in offices, with lots of computers connecting to central file servers. Sysadmins can easily control the permissions for all the PCs in a domain. On a home



Grab this example code to let your program request administrator privileges.

network you normally only have a single subnet and you don't care about centralised permissions, so it's easier to just use a workgroup (which is also the default). When you log into a domain, your credentials are checked with the domain controller. But if you connect via Wi-Fi, Windows will use the credentials cached locally. You can resync the credentials by leaving the domain and then rejoining it. If your laptop's local time is out by more than five minutes from the domain controller's time, that would also cause a login fail, but that's pretty unlikely unless you aren't automatically syncing your system clock via the internet for some reason.

Luis Villazon



If you're not logging onto a domain, you should change your PC's network settings to use workgroup instead.

Streamline file saving with a macro

Helen Bradley explains how to simplify and streamline the process of saving files using a macro.

In an office situation you may want to enforce a file naming convention so you know how files are named and where they are stored. It is easy to do this using a macro.

In our scenario we will be saving Word documents to a preset folder and using a combination of date, preset text and user entered text. The macro is designed so you can easily replace the content with data relevant to your own needs.

The macro should be stored in your Normal.dotm template so it is available to use at any time. The step by step shows how to create it. And there's example code to download at www.apcmag.com/magstuff.

THE MACRO CODE

This is the code of the macro. When run it displays a dialog to prompt for a client name which is then used as part of the filename. The filename also includes the current date formatted to display as yyyymmdd so 10 August 2015 will appear as 20150810. This is one way of including the date of

creation in the filename and you can change the format, if desired, by changing this line of code:

```
docDate = Format(Now, "yyyymmdd")
```

The path for saving the document is hard coded in to this statement:

```
docFilePath = "c:\users\\my documents\clients\"
```

You should replace <user name> with the appropriate user name and replace 'clients' with the name of the folder in which the file is to be stored (this folder must already exist and you must include the trailing backslash inside the quote marks).

If the document has been previously saved this code will save it with its original name and in its original location.

```
Sub SaveWork ()  
    If ActiveDocument.Path =  
    "" Then
```

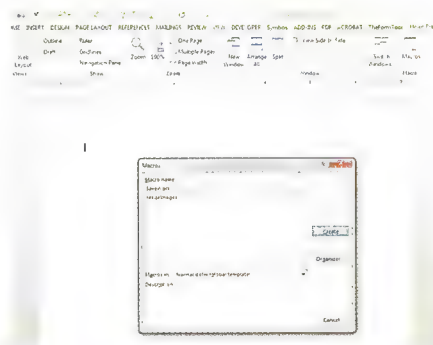
'replace <user name> and sub folder in following statement

```
docFilePath = "c:\users\\my documents\clients\"  
docDate = Format(Now, "yyyymmdd")  
docnameTxt = " Letter to "  
docClient =  
InputBox("Client", "Document Save", "Client")  
docFilename =  
docFilePath + docDate +  
docnameTxt + docClient  
With  
Dialogs(wdDialogFileSaveAs)  
    .Name =  
docFilename  
    .Show  
End With  
Else  
    ActiveDocument.Save  
End If  
End Sub
```

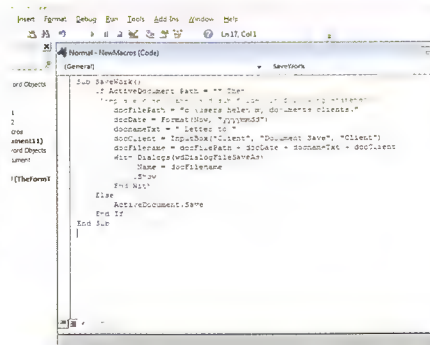
Add this code to a button on the ribbon and access it with a single click.

Naming conventions

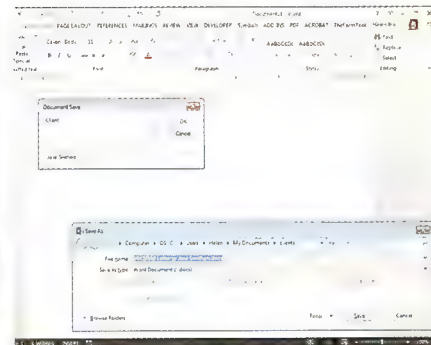
Bring some organisation to your file names.



1 SET UP
Choose 'View > Macros > View Macros' and type the name **SaveWork**, choose to save it in Normal.dotm (Global Template) and click Create. This opens the Visual Basic Editor ready for you to type the code.



2 CUSTOMISE CODE
Type the code, changing the docFilePath text to the location where you will store your documents. You can also alter the docNameTxt entry, if desired.



3 IN FUTURE
When you run the macro you will be prompted to enter a name and the macro will automatically open the correct folder for you and populate the save dialog's file name field with the details for that file. You can change any of these settings or click Save to accept them. ■

Automate iOS tasks with Editorial

Kenny Hemphill shows how to master this powerful iOS text editor and automation tool..



VISUAL GUIDE EDITORIAL'S MAIN SCREEN

1 EDITING WORKFLOWS
Tap the spanner to see a list of available workflows. From here, you can import more of them or create your own. You can also remove those you don't need. You can change its name and icon, tag it and share it.

2 EXTENDED VIEWS
This arrow accesses a screen where you can preview the current document, view Editorial's documentation, access the Console and Scratchpad, and visit web pages in a built-in browser. The Scratchpad enables experimentation with Python to create workflows.

3 BOOKMARKS BAR
If you have a few workflows you use regularly, you can bookmark them. Workflows are added from their information page, accessed from the spanner button. It's worth taking time to give them a descriptive name and icon.

4 SWITCH DOCUMENTS
This is where you open a document, either stored locally or in Dropbox. You also create new Markdown or text documents from here. Sort them by name or date, and organised in folders.

5 DOCUMENT DETAILS
Tap on the title of a document to see its word and character counts. You'll also see an outline of the document, generated from Markdown headings. Tap the pencil icon to the right of the title to edit it, or the Dropbox icon (if it's a local file) to copy it to your Dropbox account.

6 EDITORIAL'S KEYBOARD
The app's keyboard provides a number of shortcuts, including an undo button. Tap the Snippets key to its left and you'll be presented with a list of text snippets to quickly insert into a document, including one which adds today's date at the cursor when you type 'ddd'.

At its simplest, Editorial is a text editor that supports Markdown, the plain text formatting syntax that's gained in popularity in recent years and is supported by WordPress, among others.

However, there's much more to it than that. Editorial enables you to automate repetitive tasks by creating

reusable workflows. There are three ways you can add workflows in Editorial: by scripting them from scratch in Python; by putting Actions together in sequence, a bit like Automator; or by importing workflows created by others.

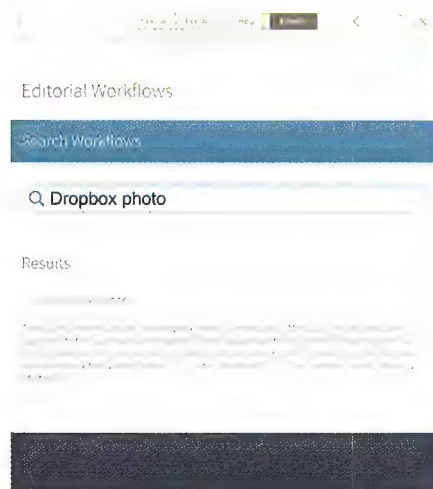
Most of us lack the skills to take the first option, but the latter two are reasonably straightforward. Having

been around for a couple of years, Editorial has a core of devotees who produce workflows and make them available for use, so you may not need to create your own at all.

As well as text, workflows can process images. The one we'll build quickly adds an image from your Dropbox folder to an Editorial document.

Use actions and workflows

Editorial can speed up your daily tasks.



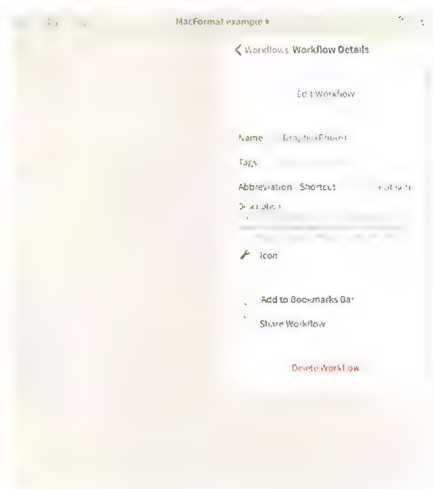
1 DOWNLOAD A WORKFLOW

To create a new Markdown document, tap the top-left icon to open the sidebar, then the button at the bottom-left. Next, tap the arrow at the top-right of the screen, tap Browser and visit editorial-workflows.com. Type `Dropbox photo` in the site's search bar, tap the title of the item under Results and then 'Install Workflow'. Confirm on the page that you want to proceed, and again in the dialog that pops up. To check it was a success, return to your document, tap the spanner icon and check the workflow is listed.



2 VARIABLES AND BLOCKS

Variables can be used to substitute values into actions' text parameters. Built-in variables include selected text, file name, and date and time formats. So, to create a letter template with 'Date:' followed by today's date, you'd create an action to insert variables that format the date how you want it to look. When you want actions to run only when a condition is met, add the Conditional Block action and put them inside it. To repeat actions for every line of text that's input, use the Repeat Block action.



3 USE IT TO INSERT AN IMAGE

Tap the 'i' next to the workflow in the list. Tap in the name field to give it a better name, then tap 'Add to Bookmarks Bar' so it's quicker to access. Go to the Dropbox app, find the photo you want, tap its Share button, then 'Copy Link'. Return to Editorial and tap the workflow in the Bookmarks Bar. It should add Markdown code for the image. If you get an error telling you the link lacks an image extension, open another text app, paste the link, remove '?dl=0' from its end, copy it again and try again in Editorial.



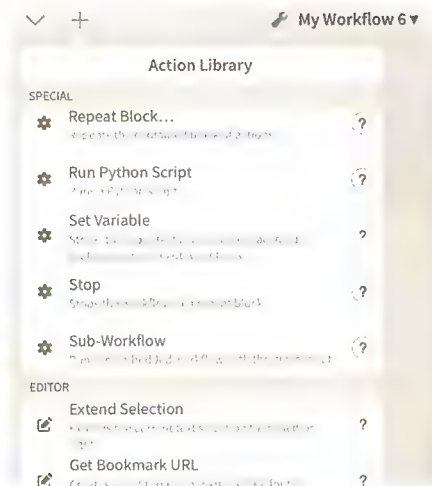
4 EDIT EXISTING WORKFLOWS

The best way to understand how actions form workflows is to examine one included with the app. Tap the spanner icon, then the 'i' next to a workflow, then 'Edit Workflow' to see its actions listed sequentially. Tap an action to see its options. To save your choices as a preset, and to rename the step, tap the down arrow at the right of the action's title bar. You can also drag an action to a different place in the sequence using the grip icon at its far right, though you don't want to do that in a pre-built workflow.



5 UNDERSTAND WORKFLOWS

Workflows in Editorial are usually made up of sequential actions (though a workflow can also be single action comprised of a Python script). Actions can do many things, such as converting Markdown to HTML, or searching for text. They have parameters that you set when creating a workflow, the types of which depend on the action. Each action takes the output from the preceding action as its input. Once you've set the parameters for an action, you can save its configuration as a preset to use again.



6 CREATE YOUR OWN

The first step in creating a workflow from scratch is to plan what you want it to do: steps to get there, conditions to meet, variables needed, and so on. Next, check out the Action Library by tapping the spanner, then '+' to create a workflow, then '+' again. Read an action's documentation by tapping its adjacent '?' and work out the order of actions based on their input and what they produce. Store things you need later in variables. Detailed documentation about Editorial is at tinyurl.com/ncljdh.

Pimp your Dock

Matthew JC. Powell shares a few tips to make OS X's Dock your own

The Dock has been a part of OS X since its earliest days, and has varied widely in its functionality and, in particular, in appearance. It's a repository for your most-used applications as well as a way of switching between currently open applications, and of course it's where you find the Trash. There are a few customisations you can make to it using System Preferences (position, size and so on) but if you're prepared to break out the Terminal you can do much more.

Add spacers. The Dock is divided into two sections: applications on one side, and folders on the other, with a divider in between. If you have a lot of applications on the Dock it can get a bit difficult to find the one you want quickly, thus reducing the utility of the Dock.

The solution would obviously be to sort applications into groups and add extra dividers. Apple, in its wisdom, has made adding such dividers nigh on impossible.

You can, however, add blank spaces to separate out your groups of applications. Open the Terminal, and type

```
defaults write com.apple.dock persistent-apps -array-add '{"tile-type": "spacer-tile"}'; killall Dock
```

and hit Return. A blank space will appear in the Dock, which can be dragged back and forth like any other

icon. If you want multiple spacers, simply run the command multiple times. To remove them, simply drag them off the Dock like any other icon.

Make the Dock a switcher, not a launcher. The same overwhelming clutter discussed above can render the Dock essentially useless as an application launcher for many people. Plus, using Spotlight to launch applications is so quick. But the Dock can still be useful as a way to switch between open applications, if you could just get it to display only the applications you're actually using.

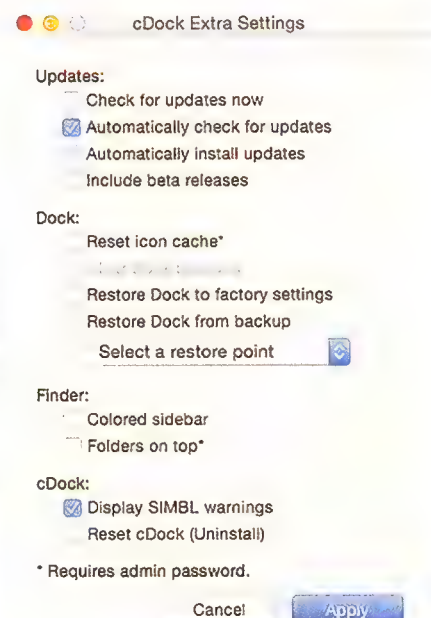
Well you can. Open the Terminal and type:

```
defaults write com.apple.dock static-only -bool TRUE; killall Dock
```

and hit Return. Now look at the Dock, and only the applications you currently have open will appear, as well as the Trash.

This essentially replicates the functionality of pressing Command-Tab to switch between applications, but with the advantage that is you click and hold on one of your open applications, you can switch directly into any open document in that application. It's minimalist, useful, and very cool.

Unfortunately you lose your Downloads folder and any other folders you've got sitting to the right of the divider, and there's apparently no way to keep those while having only active applications to the left of



One-button fix. If you've been mucking about with the Dock and it's not behaving correctly, cDock offers the option to restore it to its default settings — it's as if you never even fiddled with it.

the divider. This may be a deal-breaker. To change back to the Dock the way it used to be, run the command again, changing TRUE to FALSE.

Add recent items. The Recent Items submenu (in the Apple Menu) can be useful for getting at documents you've been working on, particularly if you're not as organised as you might be about where you save things. Many Mac users these days hardly ever use the Apple Menu, though, so it's easy to forget it's there. If the Dock is more a part of your workflow than the Apple Menu, you can add a Recent Items tile (a kind of folder) to your Dock.

Open the Terminal and type:

```
defaults write com.apple.dock persistent-others -array-add '{"tile-data" = {"list-type" = 1;}; "tile-type" = "recents-tile"}'; killall Dock
```

and hit Return. A new tile will appear between the Trash and the Downloads folder on your Dock.

If you right-click (or two-finger-tap) on this tile, you'll see a list of options for what it can contain — Recent Applications, Recent Documents, Recent Servers, Favorite Volumes and Favorite Items — as well as how you

Just recently. Adding a Recent Items tile to the Dock makes these things easier to find without going to the Apple Menu. Unfortunately, since it's a tile and not a real folder, you can't drag items from it.



Below: The final frontier. Adding blank spaces to the Dock can help keep it organised



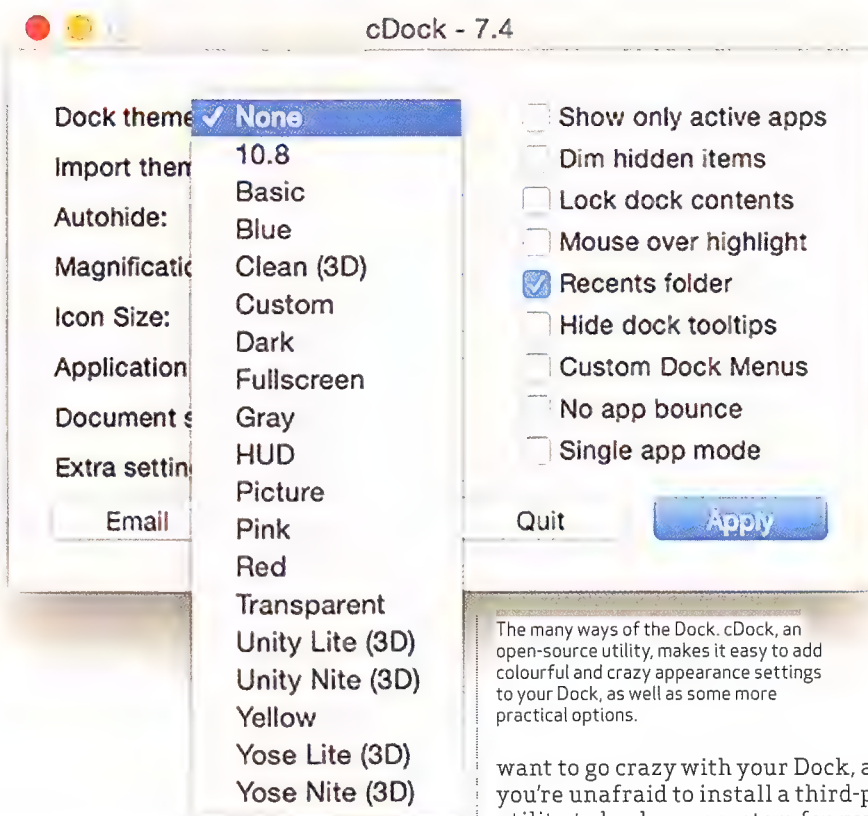
Have it your way. When you create a Recents tile, you can set it to show different types of content or simply get to servers and locations you use frequently.

Recent Applications
☒ Recent Documents
 Recent Servers
 Favorite Volumes
 Favorite Items

View content as:

Fan
☒ Grid
 List
 Automatic

Remove from Dock
 Open



The many ways of the Dock. cDock, an open-source utility, makes it easy to add colourful and crazy appearance settings to your Dock, as well as some more practical options.

want to go crazy with your Dock, and you're unafraid to install a third-party utility to hack your system for you, can download cDock from sourceforge.net/projects/cdock/.

cDock works in OS X 10.9 and 10.10 and offers most of the hacks listed above, plus others including giving the Dock its 3D appearance back (if you're into that sort of thing) and turning it wacky colours.

Among the most interesting things cDock can do is add "themes" to the Dock — colours, magnification and hiding and other settings, all changing at once. The SourceForge community also builds extra themes on a pretty regular basis, so if there isn't a theme you like yet, just wait around a bit (or request it). The transparent theme is particularly cool — icons floating about with no visible Dock at all. Given its present minimalist push, Apple should make this an option. Better still, cDock offers a simple way to restore your Dock to its default settings if, for example, you've gone and tried the various tricks in this here article and broken it. It's possible (and reasonably easy) to restore the Dock defaults using the Terminal, but the procedure varies from one version of OS X to the next. Installing cDock is comparatively straightforward. ■

"The transparent theme is particularly cool — icons floating about with no visible Dock at all."

would like it to display. Again, if you want multiple instances of this tile — so you have one for Recent Applications and one for Recent Documents, for instance — simply run the Terminal command again.

If you have a Mac-using relative who is constantly calling for tech support because "all my mail has disappeared" — meaning they've accidentally removed the Mail icon from the Dock — you'll love this one. It's also useful if you've got kids who know enough to muck about with your Mac, but not enough to leave it alone.

For this one, open the Terminal and type:

```
defaults write com.apple.Dock contents-immutable -bool yes; killall Dock
```

then hit Return. This renders the contents of the Dock "immutable", meaning nothing can be added, nothing can be removed, and nothing can be shifted around. The position, size and magnification options for the Dock are unaffected.

Of course, if you need to make changes to the Dock for your support-needy friend or relative, you'll have to run the command again, changing yes to no.

But wait, there's more. If you really



Above: The minimal look. Reducing the Dock to show only active applications gains some functionality for you at the cost of your Docked folders.



Create a 3D game with Unity

Developing games isn't easy. Robin De Jongh breaks down the process.

Developing games is hard. At least that's the general perception. And it's true if you're talking about creating a game from scratch in a general-purpose programming language.

But these days, it doesn't have to be anything like that hard. There are tools available that happen to cost absolutely nothing, and which make the whole process of creating a game a pleasure rather than a chore. Almost a game in itself. Unity, as an example, offers up the kind of graphical interface that you'd more commonly find in a simple-to-use 3D modelling tool, with cameras, light sources and models. You can have something impressive up and running in a matter of minutes, as we're going to show you.

"The game view shows you only what the audience will see."



1 GAME ON

Unity Personal Edition is free from unity3d.com. Once you've installed it, open Unity and hit 'New Project'. Name your project 'IslandRun' and in the same screen click on the 'Asset Packages' button. Tick the boxes for 'Cameras', 'Characters', 'Environment' and 'Vehicles' packages and click 'Done', then 'Create Project'. Your game assets library will take a while to load and the progress bar will show how far you have to go.

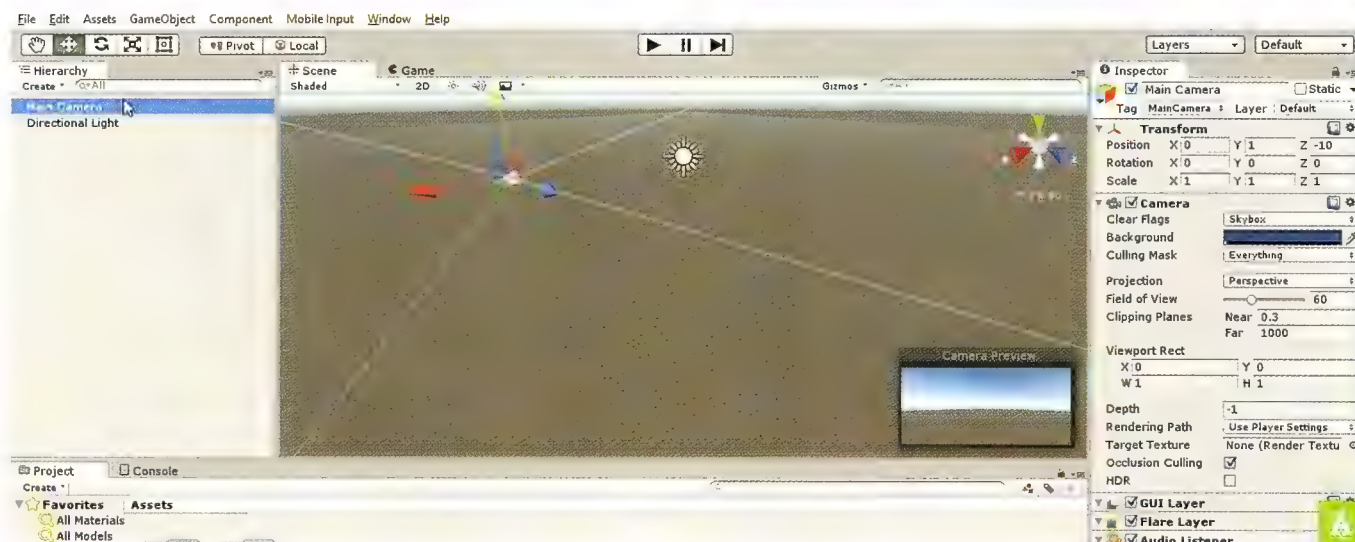
■ Once in the Unity Editor, you'll see a screen similar to any 3D modelling package. On the top you have the main scene into which you'll place your 3D or 2D objects. You could create these yourself using tools such as Gimp and Blender and import them, but in this tutorial we'll be using pre-made assets from the

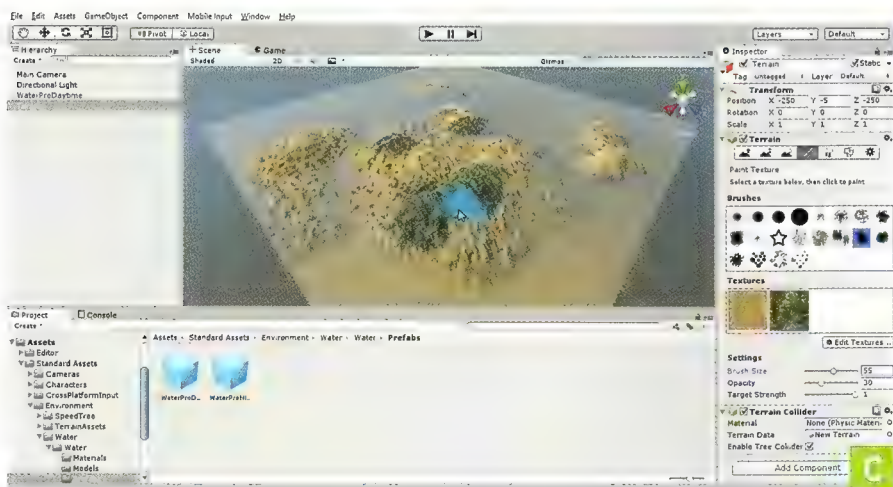
Libraries you just loaded. Think of the Scene view as a film set on which you assemble the components prior to a take.

2 SETTING THE SCENE

■ If you click on the tab above the scene view, labelled 'Game', the window will change to the game view. Continuing the analogy of a film set, the game view shows you only what the audience will see. Click the 'Scene' tab before continuing. Next to these windows, on the left, is a list of everything that's currently in the scene. Think of this as your stagehand's list. If you click on the camera in the list, it will highlight the camera in your scene.

■ Typing 'cam' into the search field at the top will isolate anything on the list with those letters in it, making it





an extremely useful way to find things in your scene if it gets crowded. On the far right of the screen is the Inspector [Image A], which will show details of the Camera you selected. Delete the letter from the search box and then select the 'Directional Light' in your Hierarchy list. You will see that the details change to those more specific to your lighting.

3 WATERWORLD

There's nothing to see at the moment, so let's get on with some world building. One of the simplest but most effective things to do it to is to start with water – it provides visual interest and some natural edges.

- Below the scene window is a project list, containing all the game assets you've loaded into the project. Select 'Standard Assets > Environment > Water > Water > Prefabs', then drag the 'WaterProDaytime' item into your Hierarchy list. It will now appear in your scene. Above left of the scene window you have five

buttons. Select the fourth one in. Click on the little box at the centre of the 'Water' prefab, hold down the left mouse button and move up. This scales the water up. Do this a few times [Image B].

4 WAVE MACHINE

The Water prefab you've inserted in your scene is a flat disc with a Material already applied to it. (For more about materials, see "How Materials Work", below). Click on the 'Play' button at the top centre of your screen and see what else it has to offer. Did you notice when you hit 'Play' that Unity executes a script that animates the bumpiness of the waves? So, what we have so far is a camera view that remains static, pointed at the horizon of a scene that has one light in it, a skybox that simulates diffused light from the sky, and a flat plane with water material applied. Finally, a script attached to the water makes the waves animate over time. Go to 'File > Save Scene', and type in 'IslandRun_Scene' and hit 'Save'.

5 CREATING THE ISLAND TERRAIN

Unity comes with Terrain editing tools that we'll now use to create an island. Go to 'Game Object > 3d Object > Terrain'. In the Inspector, enter 'X -250', 'Y -5' and 'Z -250'. This places the terrain at the centre of the Water, since the terrain defaults to a 500-wide square. The '-5' in the Y axis allows the water to be above the terrain.

- At this stage, increase the water, too, so that it stretches out further than the terrain. Select it and enter 'X 1000' and 'Z 1000'. We'll now raise various parts of the terrain to create the island. With the 'Terrain' selected, click the 'Raise/Lower Terrain' button. Select one of the rough brushes and increase its size to '100' and Opacity to '50'. Paint onto the Terrain the general shape of your Island.

- Next, reduce the brush size and opacity, then repeat to add in medium detail. Finally, use the 'Smooth Height' feature if you have a terrain that's too bumpy. Use the scroll button to zoom in and out and the middle mouse button to pan around the view. Click the 'Paint Texture' button and select 'Edit Textures' and 'Add Texture'.

- To apply and paint textures to your island, click 'Select' on the left-hand square labelled 'Albedo (RGB)'. Scroll down to find 'SandAlbedo' and double-click. Select 'Add'. You'll notice that sand has been applied to your whole Terrain. Now add another Texture in the same way, selecting any of the 'Cliff' or 'Rocky' textures. Now select it and use brushes in the same way as before to paint over the top of the sandy terrain wherever you want rock to poke through [Image C].

How materials work

Polygons and meshes build your game.

Game graphics have improved hugely over the years, but the basic format has stayed the same. Objects are made up of meshes, which in turn are made up of polygons, usually triangles or quads. Think of these as chicken mesh bent into shape with papier mache over the top. You get a 3D shape, but no detail or colour onto which materials are applied. Materials consist of a texture, which is called Albedo in Unity 5. It has the basic colour information in it.

Added to this are extras, such as a Normal map, which defines details such as grooves, cracks, bumps and scratches. A material might also have an



ambient occlusion map, which tells Unity where areas of constant shadow are, or a specular map, which controls which part of the material looks shiny. A height map is used in materials such as the terrain for our game where elevation is controlled by

the level of grey in a greyscale image. For the full lowdown, see the excellent primer prepared by the Unity team at tinyurl.com/nzld4w or the more advanced tinyurl.com/nadtmrq.

6 ADDING THE PLAYER

Let's add a 'Player Controller' so that we can walk around. In the 'Project' tab, go to 'Assets > Standard Assets > Characters >

FirstPersonCharacter > Prefabs' and drag the 'RigidBody' controller onto your Terrain. Zoom with the 'Move' button selected (top-left of the screen, second button in), pull the yellow axis up until the green bounding box just clears the ground.

■ It's time for a test drive! Click the 'Game' tab and hit 'Play'. If your character falls through the floor, go back to Scene and move the player prefab up a little more. When you press 'Play' you should be able to walk around your island enjoying the view.

■ You may notice the player can walk into water and disappear. Add another '3D Object', this time selecting 'Plane'. Scale it '200' in X and Z, then set the Transform of Y to '-1', taking it just below the water [Image D]. Tick 'Mesh Collider' but untick 'Mesh Renderer'. We've now created an invisible Plane just under the water with a Collider set just to stop anything going under the water.

■ Now to add trees. In the Terrain section in the Explorer, select 'Place Trees' and click 'Edit Trees > Add Tree'. Click the circle in the Add Tree dialog box. Select 'Broadleaf Desktop' and click 'Add'. Set Brush Size to '20' and Tree Density to '50'. Paint onto the terrain where you want trees to be.

■ Go to the button called 'Paint Details'. Click 'Edit Details' and 'Add Grass Texture'. Click the circle and double-click on a 'GrassFronD' texture. Select 'Healthy Color' and make it a little less luminous. Do the same with 'Dry Color'. Click 'Add'.



Change 'Brush Size', 'Opacity' and 'Target Strength' to '30', '0.07' and '0.07' respectively.

■ Use the brushes as before and lay down grass wherever you want [Image E]. Try your game and see how it looks, then go back and add more or remove some by holding down Shift while painting. One thing to bear in

mind is that grass only shows up when you're near it.

SETTING UP THE HUNTER

We're going to add an enemy aircraft to hunt the player. This aircraft will home in on the player rig, so they'll have to keep moving. Go to 'Standard Assets' again and find the 'Aircraft' prefabs. Drag the 'AircraftJetAI' or 'AircraftPropellerAI' into your 'Hierarchy' tab. Double-click on it to centre the view on it.

■ Use the 'Translate' button (top-left, second button) to move the craft up above the water and away out to sea. In the Inspector section, scroll down to 'Aeroplane AI Control' and then select the circle by Target. Select 'RigidBodyFPSController'. Back in the Inspector, untick 'Waypoint Progress Tracker'.

■ Try out the game. The Aircraft will come for you and probably crash. To fix this, select your invisible 'Plane' and right-click, then 'Duplicate'. Move the copy to 'Y 35' or whatever works for your terrain. Switch on the 'Mesh Renderer' temporarily to see the plane and ensure it clears the top of each peak of your terrain. ■

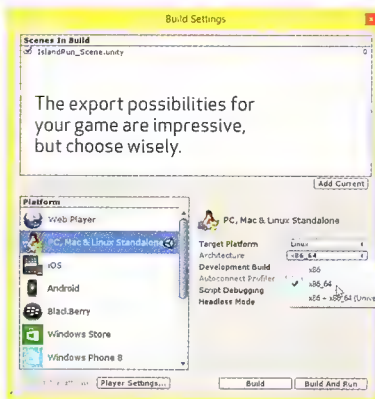
Built to game

Time to test it!

Your game should now be ready to try out outside of the Unity development environment. Save the 'Scene' and 'Project'. Now go to 'File > Build Settings'. Select 'PC Mac & Linux Standalone'. Select the Target Platform as 'Windows' and select whether you want x86 for 32-bit machines or x86 64 for 64-bit systems.

Click 'Add Current' to add your Island Scene to the build. Click 'Player Settings'. Enter your company name and any other details you wish, such as a splash screen. Click 'Build' and type in your filename and click 'Save'.

Once created, copy the executable to your test machine, (we wouldn't



recommend running it straight from a USB stick), and simply double-click it to launch your game to see if it works. That's all there is to it. Game on!

disc

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ISSUE 418, AUGUST 2015

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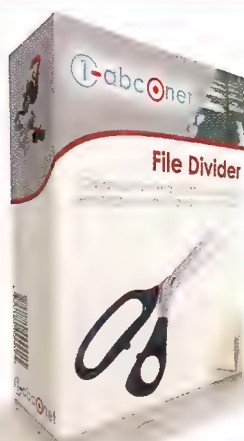
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- The interface included on the APC disc requires a JavaScript-enabled browser.
- An internet connection may be required for online registration of software before use.
- The software packages on the APC disc have different system requirements. Software is included on the disc for Windows Vista, 7 and 8.

BEFORE INSTALLING

- Check the disc using a virus scanner complete with the latest antivirus data updates. The disc was checked before burning, but new viruses are being discovered all the time.
- Back up any important system and data files. It is not recommended that the software contained on these discs be installed on production machines.
- If you have any questions regarding the use of the APC disc, click the 'Help' button at the top of the screen.

USING THE DISC

- Insert the disc into a CD/DVD-ROM reader or burner and your web browser should automatically load the interface. If not, launch your web browser and load the default.html file from the root directory of the disc.

HELP

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Boot Linux faster

Neil Bothwick goes back to the start of Linux, even before root existed.

When you boot your computer, the bootloader only needs two pieces of information: the path to the kernel and the location of your root filesystem, which is then passed to the kernel. In Grub, this would look something like:

```
linux /boot/vmlinuz-3.19.0
root=/dev/sda1
```

In practice, you will see a lot more in your bootloader entries. Anything on the Linux line after the path to the kernel file is a set of arguments that are passed on to the kernel and used by the Linux boot process, but you will usually see an extra line that starts with `initrd` followed by a path to another file in `/boot`, like:

```
initrd /boot/initramfs-
3.19.0.img
```

In the early days of Linux, the `initrd` option was not used. The kernel itself and the root filesystem contained everything needed to start the boot process and mount any other filesystems before they were needed. That changed as the amount of hardware supported by Linux increased, although it's still possible on custom systems. The kernel needs to be able to mount the root filesystem, which means it must contain drivers for your motherboard's disk interface and the filesystem used for root. As the hardware permutations increased, it

became impractical and then impossible to build everything into the kernel, so the idea of an initial ramdisk was born.

The `initrd` and its successor, the `initramfs` (they differ in technical implementation rather than usage) is a temporary root partition that's loaded into memory (hence the ramdisk name) to set up and mount the real root filesystem before passing control to it. This means you can have a ramfs that contains drivers for a variety of hardware — look in `/boot` and you will see the `ramfs` file is several times the size of the kernel. Very soon, distro makers switched to using a ramfs to boot their kernels, to support as much hardware as possible, and now we have other things to consider, such as encrypted filesystems or filesystems on logical volumes — or both.

ROLL YOUR OWN

You can make your own `initramfs`, it's a simple CPIO archive with an executable script called `init` in its root and the files needed to run that script, most of which are provided by `busybox`. You don't even need to build the ramfs yourself, it can be done during kernel compilation by setting `CONFIG_INITRAMFS_SOURCE` to the path to a configuration file (basically a contents list) in the kernel. If you are trying to build a minimal system with a pared-down kernel but still need an initial ramfs, this is the approach to take. It is well documented in the kernel documentation at `/usr/src/linux/`

`Documentation/filesystems/ramfs-rootfs-initramfs.txt`. But that's a bit hard core for this tutorial. What do you do if you need to compile your own kernel, maybe to add support for esoteric or new hardware, and need to generate an accompanying ramfs? Enter `Dracut` [stage left, wearing a velvet cloak].

In the past each distro had a custom script called something like `mkinitrd` but nowadays the tool of choice is `Dracut`. Using `udev`, and `systemd` if it is available, `Dracut` builds a ramfs that can be more or less universal. The tool is included in most distros' repositories and after installing you can generate a ramfs very easily by running:

```
dracut
```

When run without any arguments, `Dracut` generates an `initramfs` for the currently running kernel, called `/boot/initramfs-KERNEL-VERSION.img`. This fits in with the naming scheme expected by `Grub`, so `grub-mkconfig` will generate the correct menu entry for it. You can change the name by specifying it on the command line. The first non-option argument is the name of the `initramfs` file:

```
dracut newinitramfs.img
```

Unlike the distro-specific ramdisk builders used in the past, a `Dracut` `initramfs` can be universal. If you change your hardware or put your disk in a different computer, it should still work. This is because very little is hard coded, it uses `udev` to detect your hardware and then acts accordingly. This is the approach taken with distro releases, because they need to support as much hardware as possible, but if you are building a new `initramfs` for your computer, you only need to include what's needed for your computer. You do this by adding the `--hostonly` option to `Dracut` and it results in a substantially smaller — but not portable — file.

You may have noticed the reference to `Dracut` building a ramfs for the currently running kernel, which is fine if you just want a new one ramfs, but what if you have a new kernel, you need to build the ramfs before you can boot it, which you do with the `--kver` option:

```
dracut --hostonly --kver
3.19.0-custom
```

```
# PUT YOUR CONFIG HERE OR IN separate files named *.conf
# in /etc/dracut.conf.d
# SEE man dracut.conf(5)

# Sample dracut config file
#logfile=/var/log/dracut.log
#fileloglvl=6

# Exact list of dracut modules to use. Modules not listed here are not going
# to be included. If you only want to add some optional modules use
# add_dracutmodules option instead.
#dracutmodules+=" "

# dracut modules to omit
#omit_dracutmodules+=" "

# dracut modules to add to the default
#add_dracutmodules+=" "

# additional kernel modules to the default
#add_drivers+=" "

# list of kernel filesystem modules to be included in the generic initramfs
#filesystems+=" "

# build initrd only to boot current hardware
#hostonly="yes"

# install local /etc/mdadm.conf
#mdadmconf="no"

# install local /etc/lvm/lvm.conf
#lvmconf="/etc/lvm/lvm.conf"

# menu-bar options menu-set-font
```

This is the main `Dracut` config file, but you are better off putting your changes in a file in `/etc/dracut.conf.d`, to avoid it being overwritten by an update.

MORE CHOICES

Dracut uses modules, not to be confused with kernel modules, to perform the various tasks when starting the system. There is a default set used, and listed when you run Dracut, but you can add or remove modules with the `--add` and `--omit` options, which each take a space-separated list of modules, enclosed in quotes:

```
dracut --omit "dmraid mdraid lvm"
```

Typing all these options each time can be error prone, not to mention tedious, so you can place most of them in a file in `/dev/dracut.conf.d`. The name is unimportant except it must end in `.conf`, for example:

```
hostonly="yes"
omit_dracutmodules+="mdraid
caps il8n"
omit_drivers+="vboxdrv
vboxnetadp vboxnetflt vboxpci"
```

The third line excludes kernel modules. You are hardly likely to run VirtualBox from the ramfs. Once you've created your ramfs, you may want to see what's in it by using

```
lsinitrd /boot/initramfs-
3.19.0-custom.img
```

which lists the contents of the given image, or the one for the current kernel if you don't give an image file. You can also inspect the contents of individual files with the `-f` option:

```
lsinitrd /boot/initramfs-
3.19.0-custom.img -f etc/
modprobe.d/aliases.conf
```

BOOT OPTIONS

Running with a Dracut-built initramfs may require some changes to your boot options, especially if you weren't using a Dracut initramfs before. If you have built an initramfs for your currently running kernel, you can see the kernel options to use by running:

```
dracut --print-cmdline
```

You can then add the options, apart from the root setting as that is already covered by Grub, to `GRUBCMDLINE_LINUX` in `/etc/default/grub`. Dracut, like Grub, defaults to using UUIDs to identify the root partition. These are portable but not particularly readable. You can still use the old style `root=/dev/sda3` notation, or give the filesystem a label and use `root=LABEL=mylabel`. Dracut adds a number of extra boot options you can use, mostly beginning with `rd`. Some of them are quite specialist, but there are

What if it doesn't work?

The first thing to do when trying to build a new initramfs is to make a backup copy of the working one in `/boot`, by changing the extension from `.img` to `.bak`. Then if things go wrong you can press `e` key at the Grub menu and switch to the backup file.

If you add the `rd.debug` and `rd.shell` boot options, the initramfs will drop you into a rescue shell if things go wrong. Here you can try to diagnose the problem. The file `/run/initramfs/rdsosreport.txt` will have a record of the boot attempt. You should be able to mount your boot partition from the rescue shell and copy the file there, enabling you to reboot into your working option and browse the file. If you are using Systemd, the journal should also be available, read it with:

```
journalctl -ab
```

You may also find the `rd.break` option useful when debugging. Given alone, it drops to a shell when the initramfs would normally switch to the real root filesystem, but you can also give it a specific breakpoint at which to stop the boot process and drop to a shell, so you can see just what's going on. The breakpoints you can give are `cmdline`, `pre-udev`, `pre-trigger`, `initqueue`, `pre-mount`, `mount`, `pre-pivot` and `cleanup`.

If you built your initramfs with the `hostonly` option, try building a generic one and compare how that works.

```
0.865836] (arm.cma_driver_load) *ERROR* Hardware has no pinctrl
[ OK ] Found device QEMU_HARDDISK 1.
[ OK ] Started Show Plymouth Boot Screen.
[ OK ] Reached target Paths.
[ OK ] Reached target Basic System.
[ OK ] Found device /dev/mapper/fedora_localhost-swap.
[ OK ] Found device /dev/mapper/fedora_localhost-root.
Starting File System Check on /dev/mapper/fedora_localhost-root...
[ 1.844656] systemd-fsck[355]: /dev/mapper/fedora_localhost-root: clean, 2321
3784/2691872 blocks
[ OK ] Started File System Check on /dev/mapper/fedora_localhost-root.
[ OK ] Started dracut initqueue hook.
Starting dracut pre-mount hook...
[ OK ] Reached target Remote File Systems (Pre).
[ OK ] Reached target Remote File Systems.
[ OK ] Started dracut pre-mount hook.
Mounting /sysroot...
[ OK ] Mounted /sysroot.
[ OK ] Reached target Initrd Root File System.
Starting Reload Configuration from the Real Root...
[ OK ] Started Reload Configuration from the Real Root.
[ OK ] Reached target Initrd File Systems.
[ OK ] Reached target Initrd Default Target.
Starting dracut pre-pivot and cleanup hook...
[ 1.519302] dracut-pre-pivot[403]: Warning: Break before switch_root
Starting Dracut Emergency Shell...

Generating "/run/initramfs/rdsosreport.txt"

Entering emergency mode. Exit the shell to continue.
Type "journalctl" to view system logs.
You might want to save "/run/initramfs/rdsosreport.txt" to a USB stick or /boot
after mounting them and attach it to a bug report.

switch_root:~#
```

If things don't go according to plan, you will be dropped into a shell and have access to the boot logs.

some general ones. Two that are useful when debugging a new setup are:

- **rd.shell** Drop to a rescue shell if booting fails.
- **rd.debug** Output extra information, both to the screen and to the file `/run/initramfs/rdsosreport.txt`.

There are also options to control how the initramfs looks for devices to boot from. Adding `rd.auto=1` turns on looking for special devices, like encrypted, LVM or RAID. There are also specific switches for LVM and RAID: `rd.lvm`, `rd.mdraid`, `rd.dmraid`. All of these switches will need to be set to

1 to enable or 0 to disable.

When running `dracut --print-cmdline`, you will have seen `rootflags` and `rootfstype`, specifying mount details for the root filesystem. If you prefer, you can omit these and they will be read from `/etc/fstab`, provided you have given enough information to mount it in the first place. Once you have your configuration set up, generating a new initramfs is a simple matter of running Dracut. Exploring the use of Dracut is good for those that use a custom kernel or just want to know how things work. ■



Build your own Chromebook

Neil Mohr helps you install Google's other OS on an old laptop.

The first question in your head is "why would I want to install Chrome OS, even on my old laptop, when there are perfectly adequate awesome full-fat Linux distros to choose from?" Good question, and the answer is not everyone wants a full-fat distro, nor can everyone use a full-fat distro. Part of the success of Chromebooks – and they are successful with 5.7 million Chromebooks being sold in 2014 and 7.3 million predicted for 2015 (source: Gartner) – is their cut-down, lightweight Gentoo-based OS. If you want to give someone easy, no fuss access to Google services it should be a tempting choice.

The good news is that it's easy to install Chromium OS, which is the open source project name for the official Google Chrome OS, which is only available through officially licenced Chromebook PCs. While it looks superficially different with a blue-theme running through it, Chromium OS taps into the same Google Accounts and services and it offers the same

advantages of automatically picking up your plugins and the rest, which are stored in the Google cloud.

Built on Gentoo, it is Linux based and so has all the advantages of the Linux kernel, but keep in mind it was only rolled out in late 2009, so if you're planning on trying it on hardware older than that you might not have as much luck. Having said that we tried it on a standard Lenovo X200 laptop from 2008 and everything worked without a hitch. A general rule of thumb is: any standard Intel hardware should work without a hitch. One thing we do know is that non-Intel wireless adaptors do cause issues, we'll go into this in more detail in a moment.

A number of sites have maintained builds of Chromium OS. It's unlikely you'll want to build it yourself from source, so there are versions ready for VirtualBox and for running and installing off a USB drive. We're using the build maintained at arnoldthebat.co.uk as they remain current as of May 2015. Another popular build is over at the Hexxeh web site chromeos.hexxeh.net.

This doesn't appear to be maintained as of April 2013, but it will still work.

TAKE CHROMIUM OS FOR A SPIN

You've got an array of options for trying Chromium OS. The easiest of them is to download an image, write it to a USB drive or SD card and boot this from your laptop or PC. There are live disc versions too, but with writable media you're able to save your settings and carry the OS around with you.

It's not advertised within the OS but there's a command which easily copies the OS partitions to an internal hard drive. This does wipe all existing data but with cheap SSDs it's not beyond the realms of possibility you could buy a dedicated drive. We did try dual-booting Chromium with Linux Mint, but it seems Chromium saw this as a repair state and wouldn't play ball. Let us know if you have more luck, as it seems a relatively straight-forward process of recreating the two ROOT-A and STATE partitions, dd over these from the USB drive and update Grub.

Google API keys

This part of the walkthrough isn't strictly required and frankly it's a pain in the bum to implement as the keys are long and if your font obfuscates 1, L and I then it's a pain to enter as well. But if you want the Chromium Files app to work nicely with your external Google Drive account, this is the way to do it.

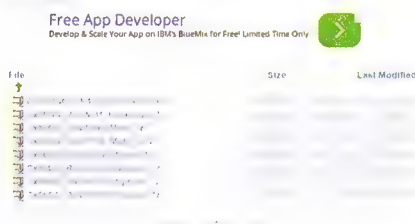
You'll need to get the keys from console.developers.google.com. Under API you need to select Credentials followed by 'Create New Client ID for Installed Applications and Other type',

then select 'Create New Key'. Two entries with your API, ID and Secret key will be listed. The second major step is adding the environmental variables to Chromium. In vi add the following three lines to the end of the configuration file along with your new keys.

```
GOOGLE_API_KEY=
GOOGLE_DEFAULT_CLIENT_ID=
GOOGLE_DEFAULT_CLIENT_SECRET=
```

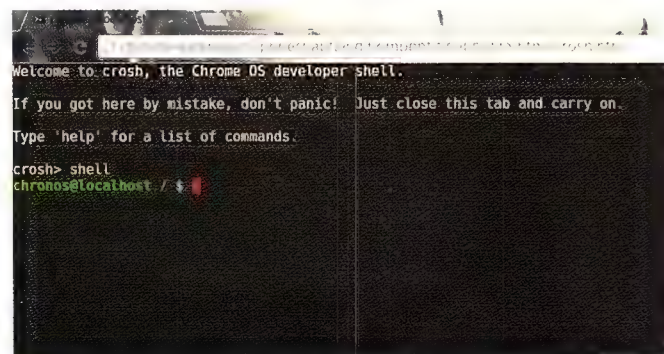

Install and update Chromium OS

Create your own Chromebook from scratch.



1 GRAB A BUILD

Grab the latest special build from tinyurl.com/o7re7lt, these retain all previous drivers, including Broadcom wireless plus untested Realtek and Atheros wireless cards. Note the Cx86OS and Camd64OS for 32- and 64-bit support, so ensure you grab the correct version for your hardware to make the most of your memory.



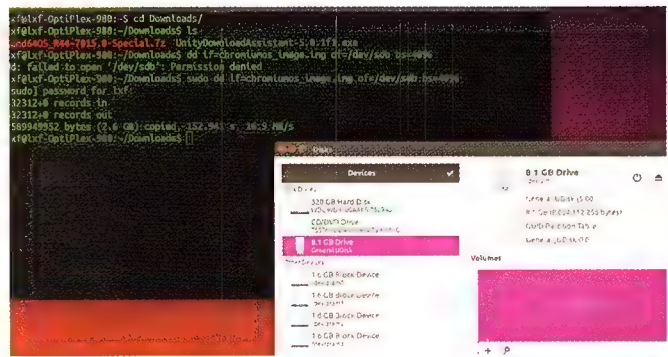
3 START CHROMIUM OS

Boot your laptop with the USB stick. You'll likely need to do the magic F12/Del/Special key to adjust the BIOS/UEFI boot priorities. You don't need to log into an account as you can use the Guest browse option. Press 'Ctrl-Alt-T' to open the developer Chrome Shell crosh. Type `shell` to open a real Linux shell.



5 GET THE API KEYS

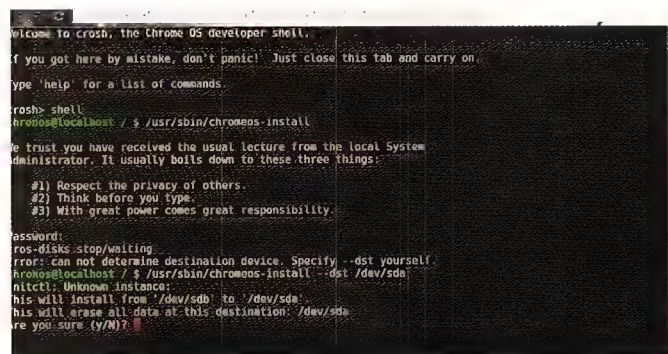
Everything will work but parts of the OS won't be able to access Google services without signed keys. Subscribe to this Google Code group tinyurl.com/cmvmwa6 then access console.developers.google.com, and select 'Create Project'. Enable Drive API/SDK, Google Maps Geolocation API, Google Now for Chrome API.



2 BOOT MEDIA

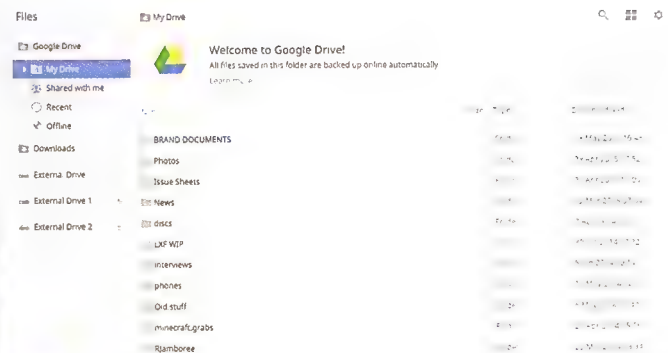
The 7ZIP file is about 1GB in size and is a 2.4GB uncompressed IMG file. This needs to be dd'd to a suitably large USB device or SD card. You are able to run and use Chromium OS from this but obviously for speed installing it on an internal SSD or HDD is the best option:

```
# sudo dd if=<ChromeOSname.img> of=/dev/sdbX  
bs=4M
```



4 INSTALL CHROMIUM OS

Warning! The next command will wipe the entire internal hard drive, we didn't have much luck with dual booting. If you're prompted for a password use password, next at the shell `# /usr/sbin/chrome-install --dev /dev/sda` and away the install will go. Once complete remove the USB stick and reboot.



6 ADD THE KEYS

The keys are case sensitive, so carefully enter them, when asked for the password, which is password. To do this open Crosh, `# shell`, `# sudo su`, `# mount -o remount,rw /`, `# cd /etc`, `# vi chrome_dev.conf` in vi enter the keys as detailed in the boxout (see left). Press `Esc wq!`, logout and log back in and Chromium Files should now have access. ■

How much RAM do you really need?

It's tempting to always get the biggest and fastest memory kit, but how much RAM do you actually need? Mike Jennings

Component lifespans are usually pretty easy to track. Processors get higher clockspeeds, more cores and smaller silicon; graphics cards get better clocks, more transistors and bigger heatsinks; and storage gets bigger and cheaper.

Memory is another component that's constantly evolving: faster speeds, bigger quantities, more channels. Conventional wisdom suggests that adding faster and larger amounts of memory will allow games and applications to run faster, but that's not always the case, which is why we've examined this murky situation.

THE MEMORY LANDSCAPE

Computer memory is divided into two main types: DDR3 and DDR4. The former is older, having debuted back in 2007, while the latter only hit the mainstream recently, with Intel's X99 platform in 2014.

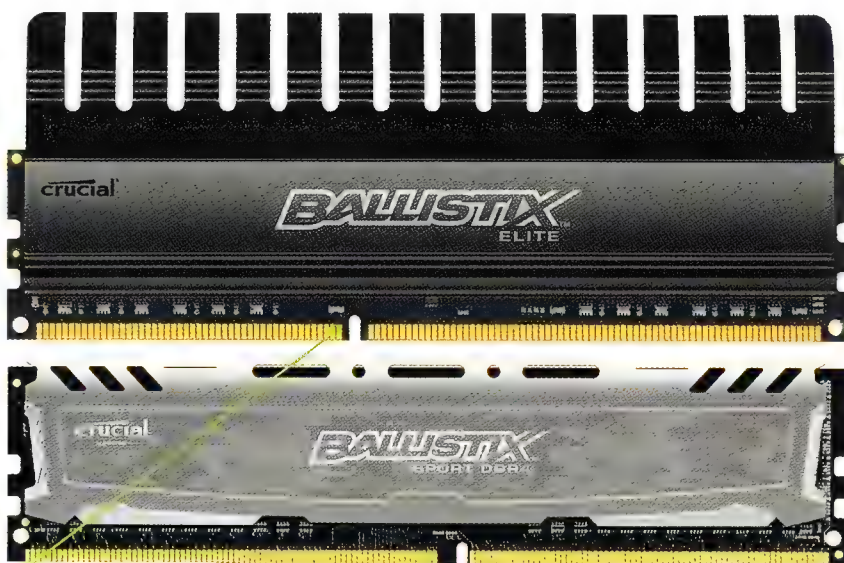
They both work using the same principle — Flash chips store data the computer needs immediately, but it's lost when it's no longer useful or the PC is turned off. It's governed by several common attributes: larger amounts

mean more data can be stored, and higher MHz ratings mean the memory runs at a faster speed.

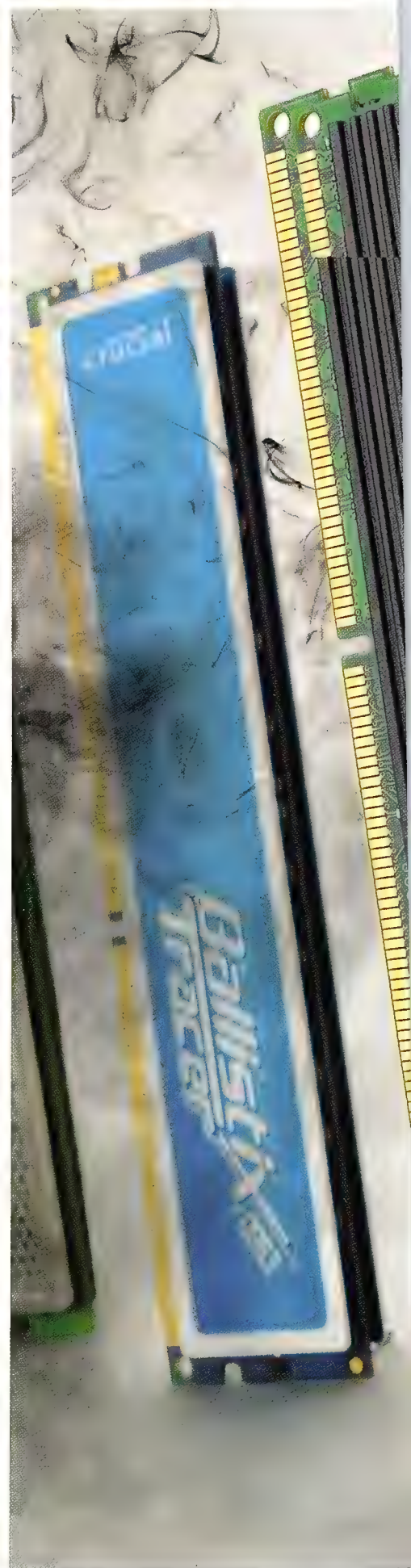
The newer standard, DDR4, has several advantages over DDR3. It runs at a higher frequency, so it's able to process tasks at a faster rate: DDR3 is generally clocked between 1,333MHz and 2,400MHz, while DDR4 ranges from 2,400MHz to 3,200MHz. It's possible to blur these lines with overclocking, but, for the most part, DDR4 is faster. It balances those better speeds with more efficient power consumption, and its chips have double the internal memory banks, faster burst access and higher data transfer rates.

DDR3 and DDR4 memory work with different motherboards and chipsets. DDR3 memory is compatible with virtually every motherboard and socket type you're able to buy right now, but DDR4 memory is only compatible with boards that use Intel's X99 chipset and LGA 2011 processor socket.

DDR4, however, does have one downside. That's increased latency. Newer DDR4 2,133MHz memory has a latency rating of CL15, which means it'll take 14.06ns to perform a read, while DDR3 1,600MHz memory reads at



Different locations of the key notch (on the insertion edge of each DIMM) prevents a DDR3 (top) or DDR4 stick (bottom) from being installed into an incompatible board or platform.





"Once beyond that 1,600MHz speed, the gaps between different memory speeds narrowed rapidly."

13.75ns. That's a tiny margin, and DDR4 negates this disadvantage with its generally higher clocks — nevertheless, if you'd like to keep an eye out, look for CAS ratings. This indicates latency, and lower is better.

No matter which memory you buy, you'll have to deal with channels. Dual- and quad-channel setups are the most popular and improve performance by allowing motherboards to use multiple channels to send and receive data simultaneously, therefore improving bandwidth. It's possible to run memory in single-channel mode, but there'll be a performance decrease if you run a single stick of memory rather than two or four.

THE CHANGING PC LANDSCAPE

The variety of different specifications means prices vary wildly. The cheapest 16GB DDR3 kits made from two 8GB sticks currently cost less than \$100, but the most expensive can cost more than \$400. It's a similar story with DDR4 too, with dual- and quad-channel kits pricing also varying by huge amounts.

Manufacturers claim that the increased speeds and better features provided by pricier kits will make a dramatic difference to your PC's performance, but we're not so sure — so we've set up some test rigs to find out just how much memory you really need.

Both of our rigs use MSI motherboards. One uses Intel's Z79 chipset with a Core i7-4770K processor, while the other is an X99 rig with a Core i7-5820K chip. Both use operating systems installed on a Samsung 850 Evo SSD, and both use an Nvidia GeForce GTX 980 graphics card.

We've already mentioned the different processors and chipsets that work with DDR3 and DDR4, but there's more to choosing components than just making sure your new gear is compatible on paper. Intel's Haswell architecture is behind the bulk of its current desktop processors, and it was first to include native support for dual-channel memory, with up to 32GB of RAM. It's used for chips that range from Celerons and Pentiums to Core i5s and Core i7s, and these desktop Haswell chips all plug in to the LGA1150 socket.

Most Haswell-based processors are deployed with mobos that have Intel's H87, Z97 and Z87 chipsets. When it comes to memory support, they're all impressive: they handle four slots which accommodate two sets of dual-channel memory, and most full-size ATX boards also support 32GB or 64GB of memory at rapid speeds.

Intel has further developed its architecture with Haswell-E. Chips that use this system also use the LGA2011 socket and X99 chipset, which means that support for DDR4 is included — and so, in turn, that means support for faster quad-channel memory when compared to DDR3.

AMD's processors and APUs, meanwhile, use the Piledriver architecture. Its own memory controller was given a speed boost over the previous generation of AMD hardware, but memory support ultimately still isn't as good on this side of the fence. All of AMD's current chips support DDR3 memory, however, some of them are restricted to 1,600MHz or 1,866MHz memory, while only a handful top out at 2,133MHz. Like Intel, these boards do support dual-channel memory.

DON'T FORGET YOUR MOTHER

Processors and chipsets aren't the only bits of kit that need to be checked before buying new memory — motherboards are also vital. You'll need to make sure a board has the right number of slots, and also check what amount and speed of memory it can accept: it's no good dropping a couple of hundred dollars on a 32GB 3,000MHz kit if your motherboard taps out at 16GB and 2,666MHz.

There are nuances to be examined, then, but for the most part the memory landscape is heartening: no matter what processor, chipset or motherboard you use, you'll be able to equip a rig with plenty of high-end memory at decent



Whether you've got DDR3 or DDR4, upping the size or speed of your memory makes little difference to Bioshock Infinite.

Elizabeth: That's all I have right now!

speeds. That's good for PC building, but it's not great news for companies flogging expensive, high-end kits.

Future developments from Intel and AMD will only improve the situation. Intel's next architecture, Skylake, will support DDR4 across all of its full-fat desktop chips – but it'll also be backwards-compatible with DDR3, which adds a huge amount of versatility. We also expect to see improvements to the memory controller and support for larger amounts of memory running at faster speeds.

AMD isn't standing still, either. Its next proper desktop architecture is called Zen, and it'll offer full DDR4 support to bring the firm's chips alongside Intel.

DDR3 MEMORY: HIT AND MISS

The first set of DDR3 benchmarks we locked and loaded were PC Mark 8's Home, Creative and Work tests – a trio of suites that simulate the kind of low-intensity tasks that take place on many systems, from web browsing and video chatting to word processing and spreadsheets.

Our first tests deployed the bare minimum of sluggish DDR3: 8GB of RAM clocked to 1,333MHz. With this RAM the rig returned scores of 5,170, 6,794 and 5,234 points in the Home, Creative and Work tests – but, with 8GB of 1,600MHz memory deployed, the scores barely improved, with the Creative run only jumping to 6,852.

There wasn't even much of a difference in these tests when we installed 16GB of 1,866MHz memory: in those three benchmarks, the machine scored 5,270, 6,961 and 2,525. The biggest leap came in the Creative test, which suggests more memory helps with photo editing and other trickier tasks, but it's hardly a game-changing jump in performance.

We saw similarly modest gains in other photo-related applications. Gigapan Stitch knits together a group of high-resolution photos, and our test image took 4 minutes and 12 seconds to complete in a rig with 8GB of 1,333MHz memory – but that only improved by 11 seconds when we doubled the RAM and upped its speed to 1,866MHz.

Other application benchmarks saw

similarly modest impacts. A Cinebench R15 CPU test with two 4GB, 1,600MHz sticks returned a result of 703; doubling the memory and improving its speed to 1,866MHz only improved that figure to 751.

We only saw big improvements in a few benchmarks when running DDR3 tests. In PC Mark Vantage, our 8GB 1,600MHz rig scored 18,313 points, but doubling the memory and running it at 1,866MHz saw that result jump by almost 3,000 points.

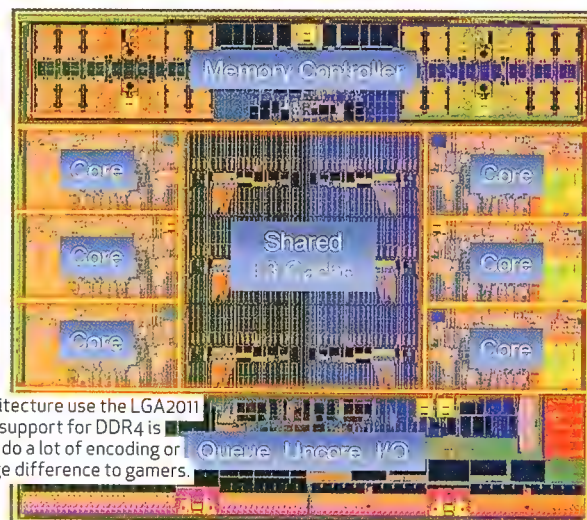
Indeed, our theoretical tests indicate that improving memory amounts and speeds does make a difference, but that these gains don't generally translate to real-world tests.

In SiSoft Sandra's multi-threaded bandwidth test, our 2x 4GB 1,333MHz setup scored 16.57GB/s, but doubling the memory and improving its speed to 1,866MHz saw that result jump to 23.33GB/s. There was a decent jump in single-threaded bandwidth, and cache bandwidth also improved when faster memory was added in larger amounts.

The leap from dual-channel to quad-channel memory doesn't often have much of an impact on our application tests, either. In Cinebench R15's OpenGL test, a



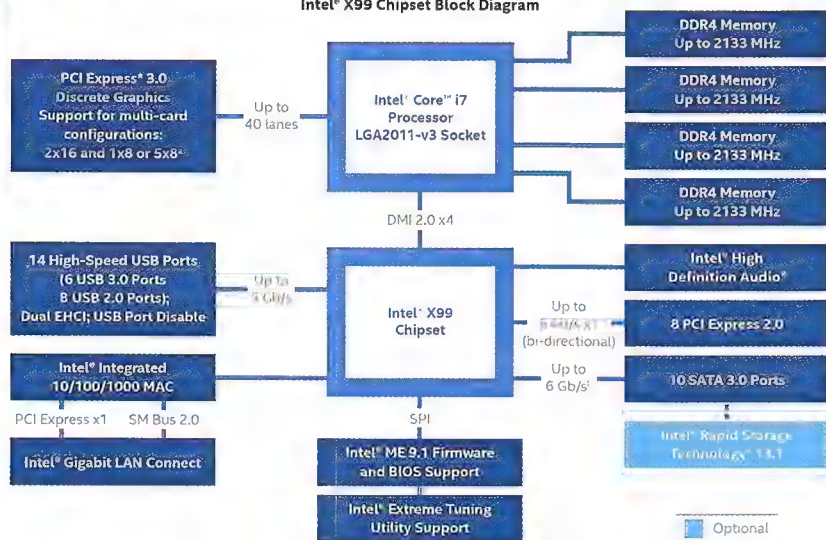
Chips using Intel's Haswell-E architecture use the LGA2011 socket and X99 chipset, meaning support for DDR4 is included. That's great news if you do a lot of encoding or rendering, but it won't make a huge difference to gamers.





Metro: Last Light was our only DDR3 gaming test to noticeably improve with more memory.

Intel® X99 Chipset Block Diagram



The X99 chipset introduced DDR4 to the (high-end) mainstream market, bringing with it faster clockspeeds and better power efficiency, but with increased latency.

machine with two 4GB 1,600MHz sticks scored 111 frames per second, with this score only jumping to 117fps with four 4GB 1,600MHz sticks installed.

When running applications using DDR3, then, the differences between slow and fast memory often aren't huge — and, as long as you've got 8GB of memory installed, then you're going to have enough to get most stuff done in real-world situations.

There was a noticeable performance difference between our rig with 1,333MHz and 1,600MHz memory installed, but, once beyond that 1,600MHz speed, the gaps between different memory speeds narrowed. We ran GeekBench's single-core benchmark on 1,600MHz memory, and then again at 2,800MHz memory, but its result only improved by around 100 points.

The benchmarks demonstrate that there are performance gains to be had by installing more memory at faster speeds, but those gains are only noticeable in high-end applications. For most of us, 8GB or 16GB of 1,866MHz memory will be more than enough.

DDR3 AND GAMING

We tested a variety of games using our DDR3 rig, but only found sporadic improvements. In *Metro: Last Light*, a machine with two 4GB 1,333MHz sticks

averaged 126fps, but improving to a pair of 8GB 1,866MHz DIMMs saw that result jump to 144fps.

In both *Bioshock Infinite* and *Batman: Arkham Origins*, though, the improvements were far less impressive — a few frames better in the minimum frame rate benchmark and only a gain of 2fps in the average frame rate result.

There wasn't much of a difference in any of our Unigine Heaven 4.0 tests, either. In all of our DDR3 tests — ranging from a system with two 4GB 1,333MHz sticks to a machine with four 8GB 1,600MHz DIMMs — the benchmark's average frame rate hovered between 63.4fps and 66.8fps. Those configurations didn't differ much in 3D Mark's Fire Strike test either: in the same range of memory setups our results only jumped between 11,607 points and 11,635 points.

THE DDR4 DIFFERENCE

Newer DDR4 memory operates with faster speeds, better channel support and Intel's latest chipset and controller, so we expected our tests to reveal bigger performance disparities.

Our initial tests, though, appeared to follow the blueprint already set out by the older DDR3 sticks. In the Cinebench R15 CPU test, a machine with two 4GB 2,400MHz sticks scored 1,143 points

Pentiums, Celerons and APUs: buying memory for a Budget PC

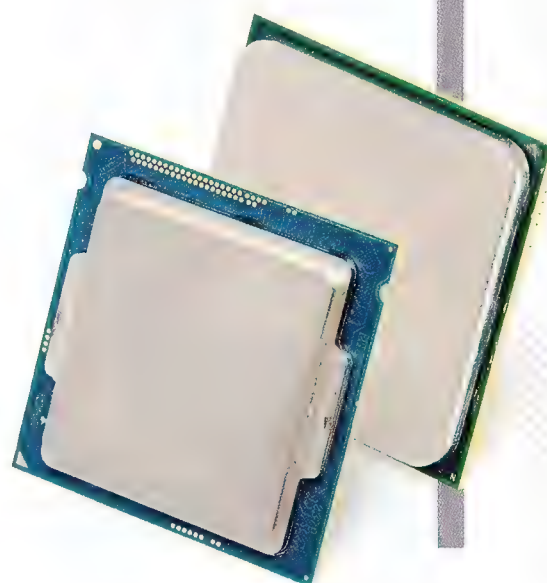
Our tests have examined the effect of different memory on high-end machines, but if you're building a budget rig, then different considerations should come to the fore at checkout time.

For starters, don't shell out on an expensive, fast memory kit if you're going to be constructing a PC built around one of Intel's Haswell-based Celeron or Pentium chips, as most of these only support DDR3 that runs at 1,333MHz. That's slow enough to cause a performance hit in many benchmarks, but on a low-end rig, it's unlikely you'll be running the sorts of applications that'll suffer with lesser speeds.

AMD's APUs are more accepting to faster memory, but you'll still need to pay attention to speeds. A couple of its cheapest parts only handle 1,333MHz or 1,600MHz DDR3, but most can support 1,866MHz sticks. It's the same on the CPU side, with FX chips mostly supporting 1,866MHz parts.

There's one other main consideration when putting together a budget machine: the motherboard. Budget boards don't often support the extreme speeds offered by pricier components, and many — especially at smaller form-factors — only have two slots, rather than four. That's fine if you're building a system you don't intend to upgrade, but it can prove restrictive if you want to add more memory later.

Don't bother with high-end memory if you're running an A10-7850K or Pentium K.





The aesthetics of memory

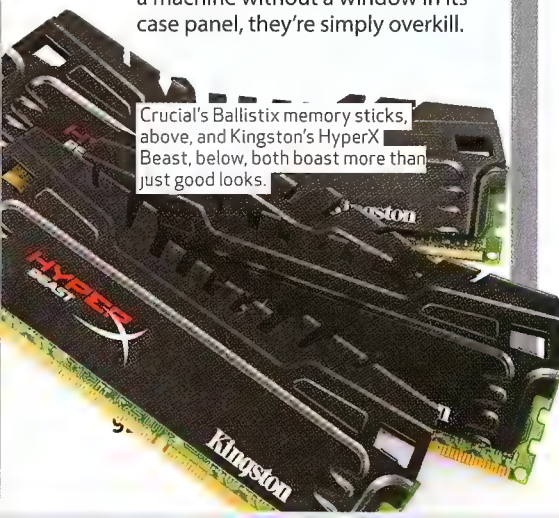
Memory manufacturers try to sell expensive kits on the basis of their size or speed, but that's not the only advantage that comes from shelling out on a high-end set of DIMMs — many of them are designed to look better than cheaper, plain-looking alternatives.

Corsair's Dominator Platinum range sits at the top of the firm's product stack, and some of its key benefits are about the visuals. Corsair boasts of its industrial design and LED lighting — the top metal bar can be upgraded with different attachments, the LEDs can also be changed, plus the box has a good-looking fan kit that can sit on top of the sticks to provide extra cooling.

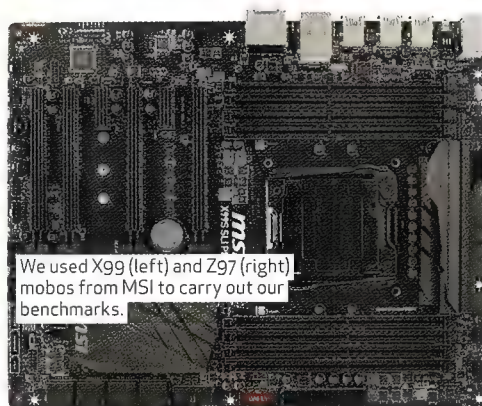
Expensive memory kits like this don't just have aesthetic advantages — Corsair's Dominator Platinum chips are hand-sorted, have improved monitoring hardware and better heatsinks. But there's no denying the visuals play a part when it comes to high-end memory.

Other firms offer similarly high-end extras. Crucial's Ballistix memory sticks have attractive aluminium heatsinks alongside practical extras like integrated thermal sensors, and Kingston's HyperX Predator and Beast products have good-looking exteriors, but are chosen specifically to provide the best performance.

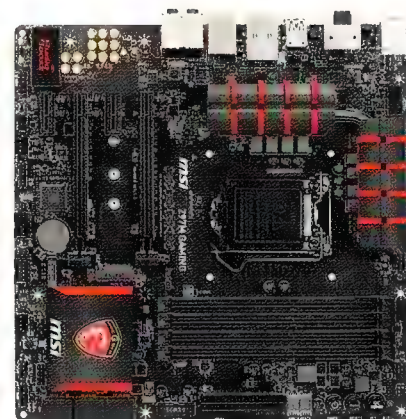
Kits like this bring practical and visual improvements to the table, then, but they're not always necessary. If you're building a mid-range rig, or want to put together a machine without a window in its case panel, they're simply overkill.



Crucial's Ballistix memory sticks, above, and Kingston's HyperX Beast, below, both boast more than just good looks.



We used X99 (left) and Z97 (right) mobos from MSI to carry out our benchmarks.



— but doubling the memory and increasing its speed to 3,000MHz only saw that result jump to 1,190 points.

We found similar patterns in the X264 video-encoding test. Our more modest rig ran through its two tests at 205fps and 68fps, but increasing the memory's speed to 3,300MHz saw those results only inch forward to 211fps and 73fps — hardly a jump that'll make a big real-world difference.

Gigapan Stitch's photo-editing tool only saw a couple of seconds' worth of improvement with its memory sped up, and Geekbench exhibited similarly small gains: our first DDR4 rig scored 22,165 points, but doubling the memory to 8GB running at 2,666MHz only saw it jump to 22,849.

It's a shame because, as with DDR3, theoretical tests illustrated that improving speeds and amounts did make a difference. With two 4GB 2,400MHz sticks installed, our test rig delivered 15GB/s and 28.58GB/s of single- and multi-thread bandwidth, with those numbers jumping to 17GB/s and 32GB/s with those same sticks clocked to 3,300MHz.

Those same benchmarks illustrated how DDR4 copes with quad-channel and larger amounts of memory: our machine with two 8GB sticks may have delivered 32GB/s of multi-threaded bandwidth, but doubling the memory saw that figure leap to 45GB/s.

Quad-channel delivered impressive numbers throughout our benchmarks, then, but those figures weren't always translated to real-world tests — so we'd say that it's not a vital addition to your PC unless you're keen on buying a Haswell-E system to run intensive work applications or the most demanding games.

DDR4 AND GAMING

We saw a big jump in just one of our gaming benchmarks, *Metro: Last Light*, while testing with DDR3. However, updated DDR4 memory proved even less dramatic. Improving the amount and speed of memory saw our *Metro: Last Light* results jump by a mere couple of frames, and our biggest improvements in *Bioshock Infinite* and *Batman* also

only saw increases of a frame or two, no matter the amount or speed of DDR4.

We'll let Unigine Heaven have the last word. Our rig averaged 62.7fps with two 4GB 2,400MHz sticks installed, but this only improved to 64.2fps once we installed four 8GB 2,666MHz DIMMs.

There's no doubt about the pure, naked speed of DDR4, but it looks like we're at the point, for gaming, especially, where any 8GB dual- or quad-channel configuration will be ample. Memory simply isn't the bottleneck in gaming. Processors and graphics cards are the components that are more likely to be holding back your frame rates.

WHAT MEMORY DO YOU REALLY NEED?

It's tempting to buy the fastest and largest memory kit you can afford when putting together a new build, but, as many of our benchmarks illustrate, aiming for the top of the tech tree is actually an unnecessary extravagance when it comes to memory.

The story is the same whether you're creating a PC to use DDR3 or DDR4. A decent amount like 8GB or 16GB running at a reasonable speed will be enough to handle most tasks you throw its way, whether it's for work or gaming.

You'll still see benefits if you buy larger and faster kits, sure, but they'll be less significant — so it's only worth looking towards these kits if you're a true enthusiast who wants the best parts available or if you're running unusually demanding software and need to wring every bit of performance from your PC.

Quad-channel kits, meanwhile, are great if you're using applications that'll truly take advantage of DDR4's improved architecture, like encoding or rendering — but most people won't feel the benefit. It's no surprise, then, that it's only available with expensive X99-based CPUs.

Most people just don't need to shell out for the priciest kits around, and that's definitely no bad thing. Memory, processor and chipset development has levelled the playing field, which means it's one less component to worry about when putting together a new PC. ■



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TECHNOLOGY. TESTED.

Build a weather station with a Raspberry Pi

Les Pounder plays citizen scientist and monitors the temperature of his home town using Python and a Raspberry Pi.

The Raspberry Pi is a great platform for science experiments as you can use it to capture and manipulate data, but how to get started? In this project we'll build a Raspberry Pi-based temperature sensor that will take samples via a sensor and compare them to data from an online weather service. This data is then graphed to show trends over time.

For this project you will need to gather together: a Raspberry Pi (any model) with a working Wi-Fi connection, a CamJam EduKit (No. 2), DS18B20 temperature sensor, 4.7kOhm resistor, three female-to-male jumper wires and a breadboard.

We'll be using the Open Weather Map for the weather data. This is a free API that offers detailed weather data globally, and as well as showing the current weather at a location, it can also show forecasts and historical information, too. To use the API, you'll need to sign up for an API key at openweathermap.org/api. Remember to keep your key safe as it's linked to you and shouldn't be shared with anyone. We'll use the key to test that we can retrieve the weather for our location, but first we need to install the pyowm module so that Python can talk to the OpenWeatherMap web site. To install this we use pip, the Python package

manager. This is preinstalled on your Raspberry Pi, so to use it, open LXTerminal (click on the desktop icon) and type the following:

```
sudo pip-3.2 install pyowm
```

Now open the Python 3 application by selecting it from the Programming menu. To open a blank file click on 'File > New'. We'll start by importing the modules. Pyowm is the Python wrapper for OpenWeatherMap, and from the time module we import the sleep function, which is used to control the speed of our code later in the project:

```
import pyowm
from time import sleep
```

Next, we'll define a function that will enable us to easily query the weather using a simple command rather than typing long sections of code:

```
def get_weather(n):
```

We start by naming the function `get_weather`. We use the `n` in brackets as an argument; an option / switch that enables us to change the location that we wish to query. Next, we create a variable called `owm` that contains our API key:

```
owm = pyowm.OWM('PASTE YOUR
API KEY HERE')
```

This needs to be pasted inside the '' to ensure that Python understands that it's a string. Note: This line is indented to show that it belongs to the function that we have just created. We now create a further variable:

```
observation = owm.weather_
at_place((n))
```

This time we call it `observation` and use it to shorten the name of a function which we will use as a location specified in our project.

CHECKING THE WEATHER

A further two more variables shorten the functions to handle retrieving the weather at our specified location and retrieving the temperature in Celsius:

```
w = observation.get_weather()
a = (w.get_
temperature('celsius'))
```

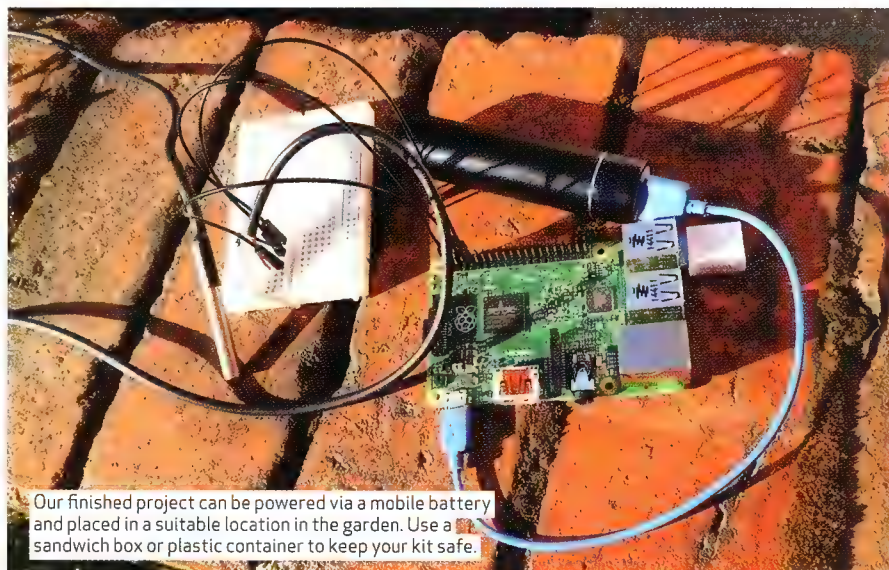
In the last line we use the `print` function to print a message to the user, in this case "The current temperature at..." but we use concatenation to join the location specified in the function, represented with the `n` variable and then we join the contents of the `a` variable to the end. Our `a` variable is rather special as it's really a Python dictionary, which stores values using a key-value pair. In this case we instruct Python to look for the `temp` key in the dictionary and return its value.

```
print("The current
temperature
at", (n), "is", a['temp'])
```

We have now finished writing our test function, so save your work and then click on 'Run > Run Module' from the IDLE menu. The Python shell will spring into life but nothing will happen, not until we call the function and give it a location.

We can pass the function our location like this:

```
get_weather("London,uk")
```



Our finished project can be powered via a mobile battery and placed in a suitable location in the garden. Use a sandwich box or plastic container to keep your kit safe.

Or we can pass it a postcode or ZIP code:

```
get_weather("W12 7LJ")
```

We should see the output via the shell as follows:

```
# The current temperature at Blackpool.uk is 9.06
```

We have successfully created a function to retrieve the weather from the Open Weather Map service. Let's now set up our temperature sensor.

SETTING UP THE SENSOR

The temperature sensor plays an important part in this project. It's used to record the temperature at our location to provide a comparison against what has been provided by OpenWeatherMap. Our sensor is a Dallas DS18B20 which looks remarkably like a transistor. Our DS18B20 is protected with a waterproof sleeve and a metal cap. This means that we can dip the sensor into a liquid and measure its temperature, just remember to be careful if the liquid is hot. At the other end of the probe we have three wires: red connects to the 3.3V pin of our Pi, the black wire connects to ground (GND) and the yellow wire is our serial line and connects to pin 4 (as it's defined in Broadcom pin-mapping) of our Pi. To safely connect the wires to our Pi we need to use a breadboard, three male-to-female jumper wires and a 4.7kOhm resistor between the 3.3V and serial line (see the diagram, p96).

With the hardware attached, power up your Pi and boot to the desktop. In order to use the sensor we need to configure our Pi, open LXTerminal and type the following:

```
sudo leafpad /boot/config.txt
```

This opens the boot config file. Navigate to the bottom of the file and add the following:

```
dtoverlay=wl-gpio
```

Save and then reboot your Raspberry Pi back to the desktop. Now we need to test that the sensor can be seen by the Pi. Open LXTerminal and do the following:

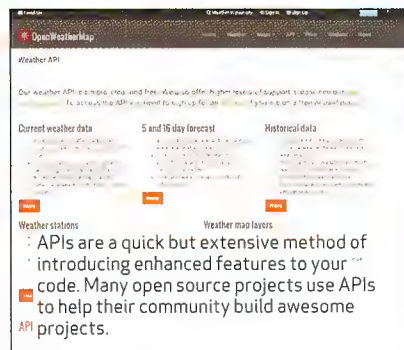
```
# sudo modprobe wl-gpio
# sudo modprobe wl-therm
```

These two commands will load the relevant kernel modules necessary to use the sensor. The sensor will read the temperature and write the data to a file, so now we need to navigate to the file so that we can read the contents:

Python and API

In this tutorial we have used two API (Application Program Interfaces) to gather the weather data from a web service and to create a graph based on the data that we have created. APIs are great fun and can really enhance your love of Python, eg we could remove the Plotly API and replace it with the Minecraft API to sculpt the *Minecraft* world based on the weather. If the OpenWeatherMap API reported snow at our location then we could have it snow in *Minecraft*. We could even create a graph to show the temperature using the blocks in the *Minecraft* world.

Another two popular API to utilise are the Twitter API via Python modules such as Twython and Tweepy, these can enable Twitter access for your projects. The last API is an SMS service based on a Raspberry Pi that can enable SMS messages to be sent from Python code. So on the hour we could receive a text



informing us of the temperature, this API can be found at www.smspi.co.uk.

There are many APIs to try and experiment with and mashing them up into one project can yield some surprising results, you could even build your own weather station that tweets and sends an SMS for you to keep an eye on the weather.



```
# cd /sys/bus/wl/devices
```

In this directory we need to look for a directory starting 28-, so start by listing the contents of the directory.

```
# ls
```

Once you have identified the correct directory, change your directory using `cd` and start typing the directory name, but then press the Tab key to auto complete the rest:

```
# cd 28-
```

Once inside the directory we need to take a peek inside the file, and for that we use `cat`.

```
# cat wl_slave
```

This will spit out a lot of code, but look for `t=`. In our case it was 17125, which if we divide it by 1,000 gives us 17.125 celsius, proving that the sensor is working correctly. We'll now use the sensor to record the temperature at our location, for this we will use the following Python code.

We start, as always, by importing the modules necessary to complete the project. In this case we use the `OS` module to enable Python to interact with the underlying operating system. The `glob` module is used to handle pathnames in the `OS`. The `time` library is used to control the project's speed:

```
import os
import glob
import time
```

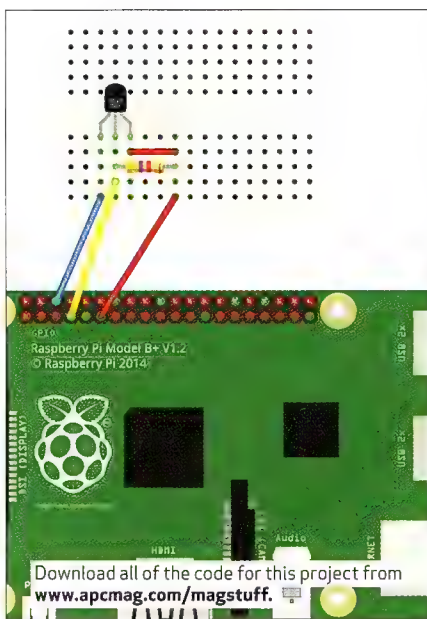

Buying the kit

In this tutorial we've used a pre-built package of components that are neatly supplied in the CamJam Edukit No.2 called Sensors. This kit retails for around US\$11 via stockists, such as The Pi Hut (thepihut.com) and is a cost-effective way of purchasing the components necessary for this project.

The price of the DS18B20 is US\$6.30 for the standard component, but the version included in the CamJam kit is a special waterproof version that's attached to a long wire, and enables the sensor to be hung out of a window while keeping your Raspberry Pi safe indoors. Along with the DS18B20, the kit includes: a breadboard, resistors, wires and other components to make more projects. (There's also a series of worksheets available online for you to use).

There are other temperature sensors on the market, such as the popular DHT11 and DHT22, but these sensors use a different method to interface with the Raspberry Pi. The DHT11/22 uses an analog output to send data to a board.

For an Arduino board this is a simple matter of connecting the components to the analog ports, but the Raspberry Pi doesn't have any of these. So to use these sensors on your Raspberry Pi you'll need to use an ADC, Analog to Digital Converter, to enable your Pi to read the data. We found the DS18B20 to be a much more cost effective and simpler sensor to work with. The CamJam kit also comes in a handy tin so you can easily and safely store all of the components in one place.



We now use the system function from the OS module to load two drivers into the kernel, one for the GPIO and the other for the temperature sensor.

```
os.system('modprobe wl-gpio')
os.system('modprobe wl-therm')
```

We next create three variables, the first handles the location of the temp sensor in the filesystem. The second uses glob to find the directory that contains the sensor data. Last, the final variable is used to add the name of the file containing the temperature data to the previous variable:

```
base_dir = '/sys/bus/wl/
devices/'
device_folder = glob.
glob(base_dir + '28*')[0]
device_file = device_folder +
'wl_slave'
```

We next come to two special lines of code. Our first line creates a global

variable called temp_c that can be used inside and outside of a function that we shall create later. The next line creates a blank list. Lists are similar to arrays in other languages into which we can later store temperature data.

```
global temp_c
sensor = []
```

We now create a function that will read the temperature stored in the device_file variable we created earlier. We open the file as read only, read the information inside it, close it, then print the information to the shell:

```
def read_temp_raw():
    f = open(device_file,
'r')
    lines = f.readlines()
    f.close()
    return lines
```

Our next function handles reading the raw temperature data from the sensor and manipulating it by stripping the superfluous information. This is then formatted by dividing the value by 1,000, leaving us with a usable temperature:

```
def read_temp():
    global temp_c
    lines = read_temp_raw()
    while lines[0].strip()
[-3:] != 'YES':
        time.sleep(0.2)
        lines = read_temp_
raw()

    equals_pos = lines[1].
find('t=')

    if equals_pos != -1:
        temp_string =
lines[1][equals_pos+2:]
        temp_c = float(temp_
string) / 1000.0
        return temp_c
```

We now use a for loop to iterate five

times, each time it will print the temperature from the sensor, add the temperature data to the sensor list and then print the list data before waiting 3,600 seconds (one hour) until it repeats the process:

```
for i in range(5):
    print(read_temp())
    sensor.append(temp_c)
    print(sensor)
    time.sleep(3600)
```

With the code complete. Save and run the code using 'Run > Run Module'. Feel free to change the final sleep duration to a shorter interval for testing.

SETTING UP PLOTLY

Now we need to install the graphing part of this project, and this is handled using Plotly, a web based graphing solution which has a great Python API. You will need to set up an account with Plotly (plot.ly) and get an API key.

Once you have your key, open LXTerminal on your Raspberry Pi and install the modules:

```
# sudo pip-3.2 install plotly
```

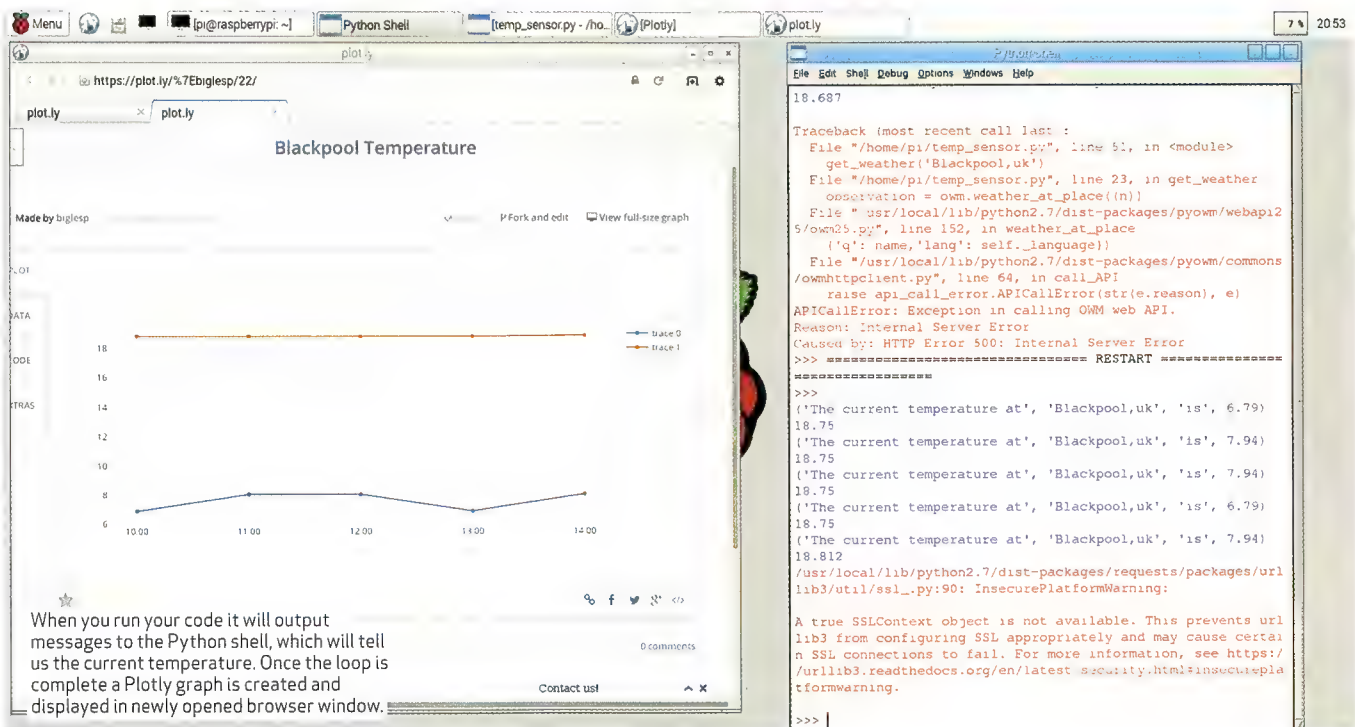
Now we need to tell Plotly what our username and API key is. In LXTerminal type the following (as one long continuous line of code):

```
# python -c "import plotly;
plotly.tools.set_credentials_
file(username='YOUR USERNAME',
api_key='API KEY', stream_
ids=['STREAM ID', 'STREAM
ID'])"
```

All of this information can be found via plot.ly/python/getting-started once you have set up an account.

PUTTING IT ALL TOGETHER

We've created the basics of our project and now it's time to put it all together. Make sure that you are using IDLE with sudo powers,



you can do this via LXTerminal with:

```
$ sudo idle3
```

We start by importing the modules for operating system, pathnames, weather API, timing and graphs:

```
import os
import glob
import pyowm
from time import sleep
import plotly.plotly as py
from plotly.graph_objs import *
```

Next, we store our API keys for OpenWeatherMap and Plotly in a central location.

```
py.sign_in('USERNAME', 'API
KEY')
key = ('API KEY')
```

We load the kernel modules for the sensor:

```
os.system('modprobe w1-gpio')
os.system('modprobe w1-
therm')
```

We create the variables to store the sensor device location, sensor temperature data and then create three lists.

Our x axis contains the periods we are recording: eg 10am to 2pm. Y is a blank list used to store the temperature data that we retrieve from OpenWeatherMap, and the sensor list is blank, and used to store our sensor data:

```
base_dir = '/sys/bus/w1/
devices/'
device_folder = glob.
glob(base_dir + '28*')[0]
device_file = device_folder +
'/w1_slave'
global temp_c
x = ['10:00','11:00','12:00','
13:00','14:00']
y = []
sensor = []
```

We create three functions. The first retrieves the weather details from OpenWeatherMap and is very similar to the first part of the project, the only difference is the last line of get_weather(n) is used to add the temperature data to the y list that we created earlier.

```
y.append(a['temp'])
```

The next function, read_temp_raw() remains the same as our previous example, but read_temp() has the conversion to Fahrenheit removed and adds the global variable temp_c so that we can use it in and outside of the function.

We then move to using the code in a for loop that iterates five times. It retrieves the weather for Blackpool,uk and then reads the temperature via the sensor. Both the sensor and OpenWeatherMap readings are written to their respective lists, using the append function. We then print the sensor temperature to prove that it has been collected. Last, we sleep the code for 3,600 seconds (one hour), and capture data every hour five times:

```
for i in range(5):
    get_
weather('Blackpool-uk')
    read_temp()
    sensor.append(temp_c)
    print(temp_c)
    sleep(3600)
```

Our last piece of code creates a scatter graph from our data. We have two traces: Trace0 is our OpenWeatherMap API data for the y axis, and the x-axis uses hard coded times. For Trace1 we use the same x-axis data, but for the y-axis we use the sensor list data. We then package the data into a list and then post the data online to plot.ly with the filename currently set to Blackpool Temperature, feel free to change it:

```
trace0 = Scatter(x=(x),y=(y))
trace1 =
Scatter(x=(x),y=(sensor))

data = Data([trace0, trace1])

unique_url = py.plot(data,
filename = 'Blackpool
Temperature')
```

With your code complete, click on 'Run > Run Module' to run and collect the data. Once complete it will automatically open a browser window and display a plot.ly graph. Congratulations you've completed the project! 🎉

Dial M for Android

Android M will usher in a new era of smartphones. Darren Yates investigates Google's next-generation Android OS and the major advances we'll see.

Android has come a long way in a relatively short space of time since its launch in the HTC Dream in 2008. With Google's popular I/O conference having come and gone for another year, the search giant has pulled back the curtain on its next Android release, for now called 'Android M'. Not only will it pick up where Lollipop left off in terms of power management, it'll coincide with some impressive new features such as faster charging speeds, thanks in part to the arrival of new USB hardware. Here's a taste of what we can expect to see later this year.

USB-C SUPPORT

It'd be a fair bet that no device designer would have looked on the microUSB3.0 connector with any great fondness. But they'll likely have breathed a collective sigh of relief with news that Android M will support the new – and much more

compact – USB Type-C connector. Given it's the same (and only) port you'll find on the new MacBook Air, it could spell a new era of connectivity for Android devices.

USB-C can deliver up to 10Gbps data transfer speeds, but it's the breadth of data signals it can support that will provide promise. Expected are power and USB, but the ability to also transfer DisplayPort, HDMI and even VGA could open up multiple 'second-screen' options.

There's also another interesting possibility – in late-May this year, Samsung filed a US patent application for a dual-OS phone that plugs into a laptop shell, transforming it into a Windows notebook. Like the ASUS Transformer, but using a phone instead of a tablet, the patent speaks of a dock connected 'through a serial interface method such as USB and HDMI' (tinyurl.com/p9n7y4p). Samsung has promoted MHL (Mobile High-definition Link) for years, but this is an application just crying out for USB-C.

However, at this stage, it's still too early to know which signaling standards USB-C will support in 'M' – and Google isn't saying much for now. The inclusion of DisplayPort, HDMI and VGA would come under what's known as the 'USB Alternate Mode' umbrella, if it happens. But USB-C has plenty of other advantages – it's reversible, so no more trying to figure out which side of the connector is 'up', and it's also backward-compatible, so you're old USB2.0 gear will still connect (albeit with an adapter).

The shortcomings of microUSB2.0 were apparent when OTG cables couldn't accept a power feed to the host and MHL and USB couldn't be supported at the same time. Hopefully, USB-C will overcome these issues and provide one connection to truly rule them all. That said, Intel has already shown off 40Gbps transfer rates in Thunderbolt 3 ports at the recent Computex trade show in Taiwan, so we'll wait and see.

USB-C: FASTER BATTERY CHARGE TIMES

As smartphone batteries continue to increase in capacity, charge times are



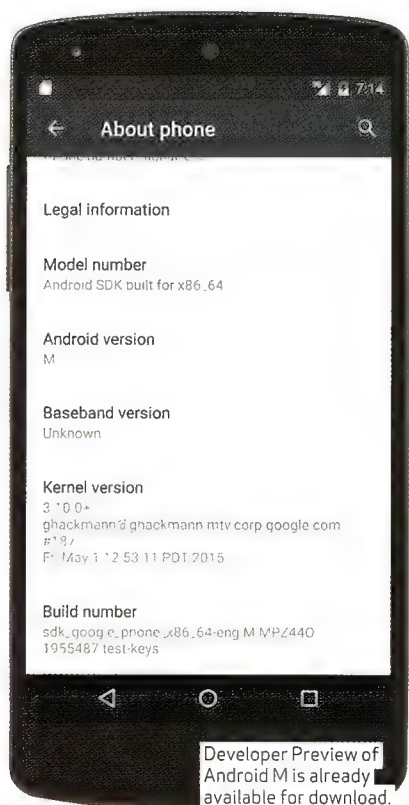
HTC has announced the One M9 will receive an Android M update – sometime.

rising, almost in lock-step. The good news is USB-C should improve that markedly. Within the spec, USB-C cables can supply up to five amps (5A) of current – double today's levels and part of USB-C's ability to supply an impressive 100-watts of power (20VDC @ 5A). Again, it'll be up to device manufacturers to determine just how fast device batteries will charge, but this should make a significant difference.

USB-C: PORTABLE POWER SUPPLY

Another new feature of USB-C we do know will appear in Android M is the new USB Power Delivery 2.0 specification, which enables your phone to act as a power supply for charging USB-connected devices such as a Bluetooth headset or fitness tracker. You'll see a new pop-up menu when you plug in a USB-C device asking you what type of connection you want to make – 'power supply' is one of those options to choose from.

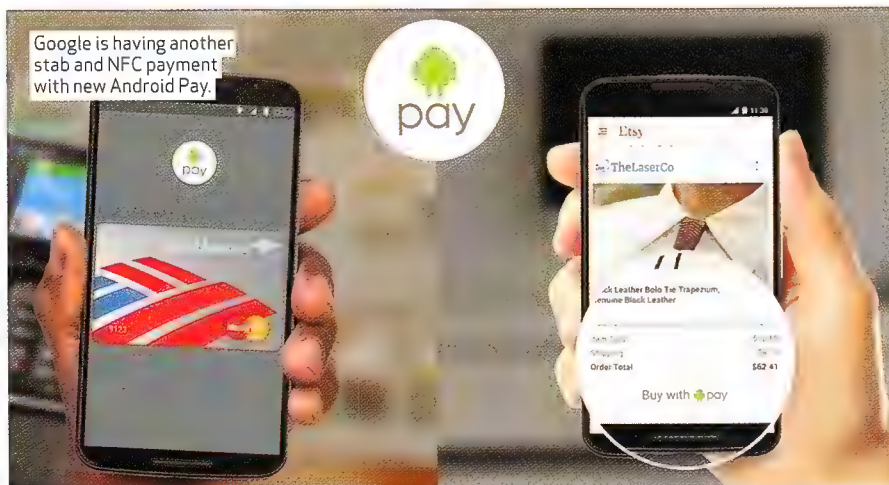
That said, you can do this already with existing phones – plug a USB-OTG cable into a supported device acting as power source and the device you want charged into the other end. Existing USB-OTG specs on the supply of current are vague, but we've pulled 460mA of current out of a Samsung Galaxy S3 via USB-OTG and maintained a within-spec 4.96VDC. However, we don't know the long-term device-health ramifications.



Native support for MIDI devices is coming to an Android M device near you.



Google is having another stab at NFC payment with new Android Pay.



Doze uses the device's sensors to perform motion-detection in determining if the device has been left unattended.

DOZE MODE

With the arrival of Lollipop, Google announced power management was high on the agenda through Project Volta. That gets ramped up in Android M with the new Doze Mode. Doze is the most granular of Android's power management efforts so far, putting individual apps into a 'deep sleep' hibernation that essentially cuts them off from the rest of the world, but still allows alarms and high-priority push messages to pass through. However, it's still unclear how much of the device wakes up at this point.

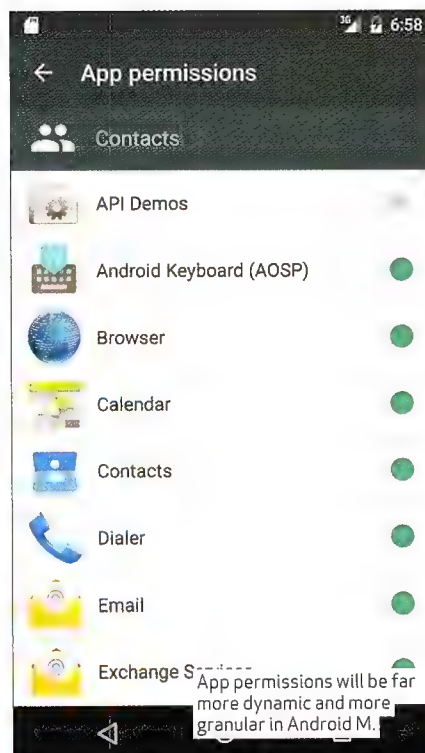
To start with, Doze uses the device's sensors to perform motion-detection in determining if the device has been left unattended. At this point, background app activity is backed off 'exponentially' in what Google says is a trade-off between 'app freshness' and battery life (tinyurl.com/p8dmh45).

From there, network-access is switched off, wake-locks are abandoned and importantly, syncing is greatly reduced during hibernation. These changes will happen at an OS-level, so it shouldn't matter if your apps are coded for it or not.

Although Android M is only available as a Developers Preview for a limited number of Nexus devices, we're already hearing reports of double the standby battery life being obtained, thanks to Doze.

APP PERMISSIONS

Google has also had a serious change of heart when it comes to app permissions. Rather than having the user make a judgment call on permissions at the time of installation, apps will be able to trigger user permission requests at runtime, when the app is being used. The fine-grain



control will allow you to permit or deny app-to-app or app-to-function transfer, making the whole thing much more dynamic. It might also make it feel like Windows Vista's 'cancel or allow' user-account control – we'll have to wait and see. The Settings menu will house all of the permissions enabled for individual apps. Google is bullish about this and already prompting developers to start taking this into account with new code (tinyurl.com/ortl2bc).

ANDROID PAY AND FINGERPRINT API

Mobile payment services are about to get more competition with the arrival of Android Pay. The idea is you'll use your 'M' phone to pay for services and products from participating stores. Sound like Google Wallet 2.0? Maybe. According to Google, Android Pay will be accepted in over 700,000 stores and 1,000 mobile apps when it arrives. But some suggest the key difference this time around is its bundling into phones by some of the big US telcos, including AT&T and Verizon, combined with support from credit card vendors including MasterCard and Visa.

And to beef up security, Google is incorporating native support for fingerprint scanners into the new OS. Word is fingerprints will be able to unlock devices and authenticate payments.

ARE FINGERPRINTS SECURE?

Fingerprint recognition might be quick and efficient but there are still lingering doubts about its security.

Android M will implement fingerprint security through Android's KeyStore feature, allowing the use of cryptographic keys. Developers will be able to access the fingerprint scanning application programming interface (API) and implement it in their apps. The device will also be able to deliver haptic feedback to acknowledge successful authentication to the user (tinyurl.com/pc8lqke).

However, it's quite possible Android M could utilise new tech coming from chipmaker Qualcomm. Earlier this year, Qualcomm revealed a new fingerprint scanner using ultrasonic soundwaves to create more accurate 3D scans of fingerprints. According to reports, it's compatible with all current Snapdragon chips and will likely begin appearing in new devices released in the second-half of 2015 (tinyurl.com/kvooj9n).

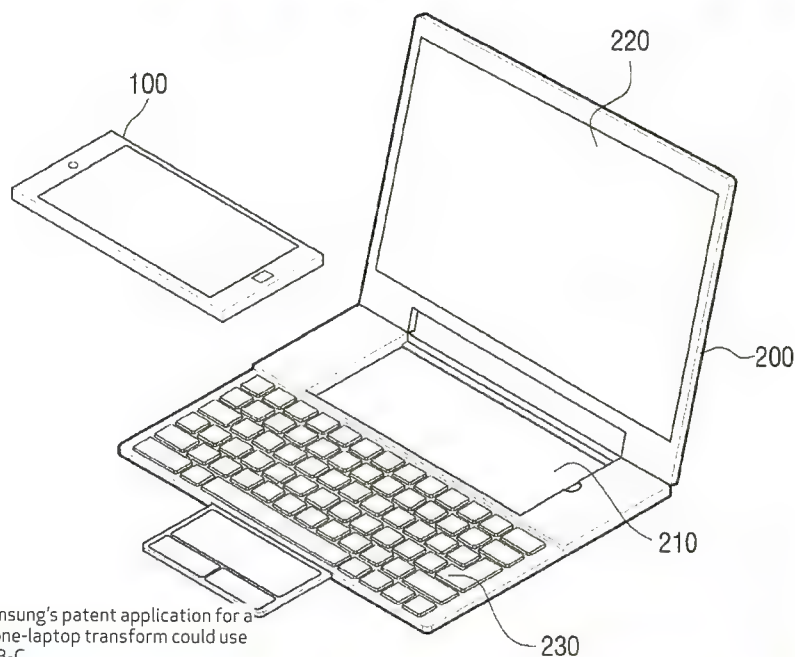
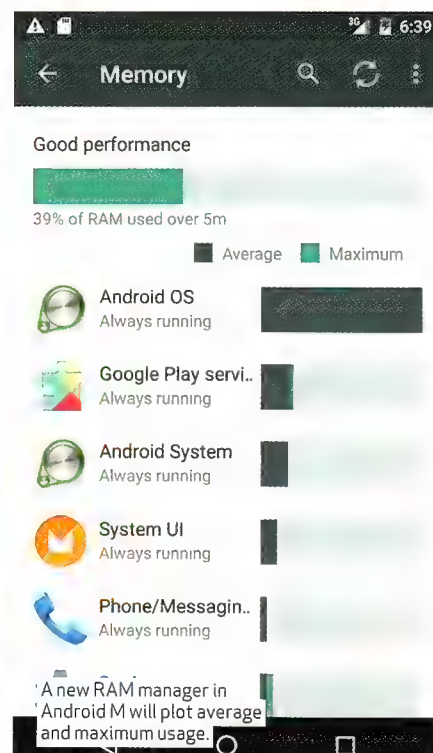
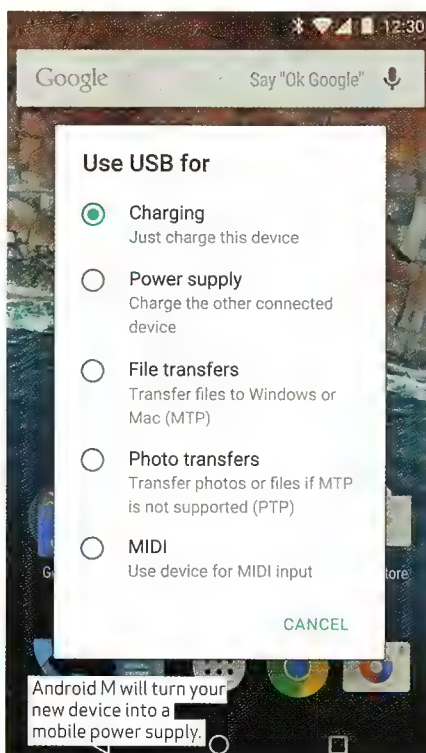
EXTERNAL STORAGE BECOMES INTERNAL

This will sound a bit strong, but... about bloody time! Getting Android to play nice with external storage has always required patience, but in a surprise turnaround, Android M will allow users to 'adopt' external microSD storage as though it was internal. It's called 'Adoptable Storage Devices' (tinyurl.com/p3ntgwu) and among other things, the feature will allow users to move apps and app data to external devices by formatting and encrypting the storage as if it was internal. Nothing in 'M' is set in concrete until it's released, but Google is already directing developers away from hard-coding file paths into apps (never a good idea anyway), so it could well be here to stay.

Interestingly, Android M is available as a developer's preview on Nexus devices – devices that don't have microSD support. However, Google has ADB Shell code allowing developers to adopt a USB drive connected via USB-OTG port on existing devices for testing.

4K DISPLAY OUTPUT

We're not sure where the content will come from (outside of games and Netflix), but Android M devices will be able to request up to 4K resolution from connected device panels. Android M will power next-generation 4K TVs, so this support isn't that surprising. It will include a new 'android.view.Display.Mode' Java instruction to query the current resolution setting and use Android's WindowManager to set it to 4K. Interestingly though, the user interface will only be rendered at the original resolution and upscaled to 4K. Devs will need controls such as SurfaceView to show content at native 4K resolution (tinyurl.com/npa2zwg).



Samsung's patent application for a phone-laptop transform could use USB-C.

5GHz HOTSPOT SUPPORT

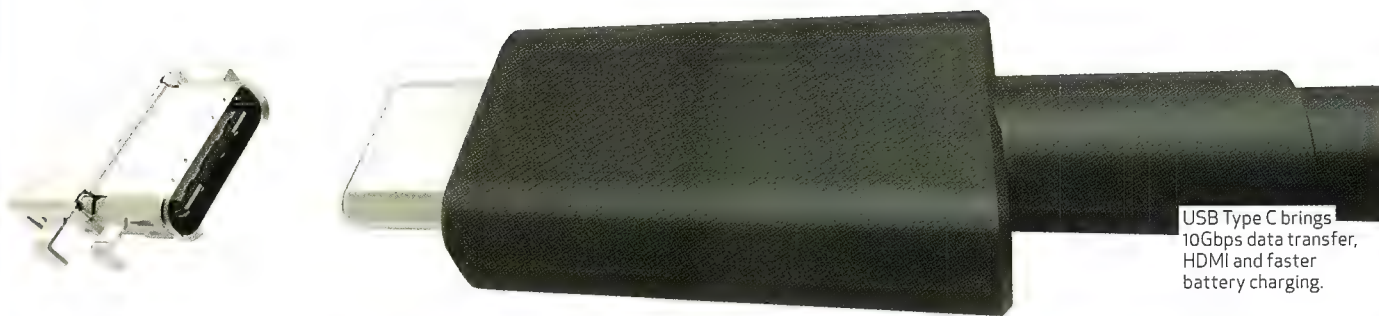
With the 2.4GHz spectrum so overcrowded these days, support for 5GHz-band hardware has gathered momentum out of sheer necessity, despite the fact 5GHz signals don't travel as well. Android M gets a Hotspot 2.0 upgrade acknowledging that growth, allowing users to select 2.4 or 5GHz band for use.

Of course, you'll need a phone with dual-band Wi-Fi hardware for it to work, but the option will be welcome, all the same, particularly within business circles.

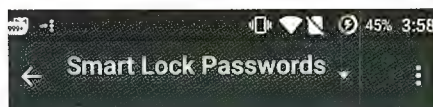
SMART LOCK PASSWORDS

This next one isn't exclusive to Android M, but appears to more or less coincide. Google has debuted a new feature called Smart Lock Passwords, a new password manager designed to reduce the need to sign into every online service that asks you to. In fact, the word is Smart Lock Passwords is being shipped out through a Google Play Services update to all Gingerbread/2.3 or newer devices (we've already seen it on Lollipop/5.1.1).

The idea is that once you login, you shouldn't have to keep logging in.



USB Type C brings 10Gbps data transfer, HDMI and faster battery charging.



Preferences

Smart Lock for Passwords and Connected Accounts

Allow the passwords of your apps and websites to be saved to your Google account. When disabled, no passwords will be saved or returned from this account.

Auto sign-in

Automatically sign in to apps and websites connected to your account. When disabled, you will be asked for confirmation every time before signing in to an app or website.

Saved Passwords

Saved passwords can be viewed and modified at <https://passwords.google.com>

Never save

Smart Lock Passwords, coming to Android M, but available in Lollipop now. not to be sav...



"With the 2.4GHz spectrum so overcrowded these days, support for 5GHz-band hardware has gathered momentum out of sheer necessity!"

Google has already set up a page for developers on how to use it (tinyurl.com/op2o9aw) and developers are encouraged to include it into new apps. Users logging in for the first time will be given the option of having their credentials stored for automatic login in future. They'll also be able to see their settings online at passwords.google.com.

APP/DATA BACKUP

One new feature that will appeal to anyone who has swapped phones will be the new Auto Backup for Apps. As the name suggests, it will allow apps and app settings data to be automatically backed up to a user's Google Drive account. For now, users will be able to store up to 25MB per app without it counting in their Drive quota. However, Google's wording is ambiguous as this 25MB limit applies 'during the M Preview period' (tinyurl.com/ocvoqkl). What happens after M is released proper remains to be seen.

In any case, apps backed up and reloaded should do so with original settings intact. Nice.

MIDI DEVICE SUPPORT

The Musical Instrument Digital Interface has been around since the 1980s, but doesn't look like going away any time soon. In fact, Google is making sure it won't, baking native MIDI support into Android M. This comes on top of native USB audio support and improved latency introduced in Lollipop. As we showed you back in the June 2015 issue of APC, Android has supported USB audio recording since at least Honeycomb/Android 3.1 — provided you supply your own USB Audio class drivers.

Music creation has long been an area iOS has had it all over Android and while the new features introduced into Lollipop and here in 'M' may not necessarily put Android out in front, they'll at least plug a hole. (Again, USB MIDI controllers are supported in

Android already, if you bring your own drivers — apps like Audio Evolution Mobile can do it now provided you have USB-OTG and Honeycomb/3.0 or newer OS onboard).

WHICH DEVICES WILL GET IT?

Of course, the major question is which devices will get an Android M OTA update? With the Nexus 5, 6 and 9, plus the Nexus Player already getting Developer Previews of Android M, it's odds-on they'll get an update. HTC has said its flagship HTC One M9 and M9+ phones will get it, while rumours are growing a decent list of Samsung devices, including the Galaxy S6/Duos/Edge, Note 4/Duos, Note Edge, Alpha and Tab A will also receive it.

Android M should arrive during Q3 2015, possibly as late as September. Unless manufacturers and telcos break with tradition, its unlikely OTA updates will start appearing in Australia until year's end. But we can always hope. ■

How to power your Arduino projects

Getting power to your Arduino projects can be done in a number of ways. Darren Yates reveals your options.



This emergency charger generates USB power from two NiMH AA-size cells.

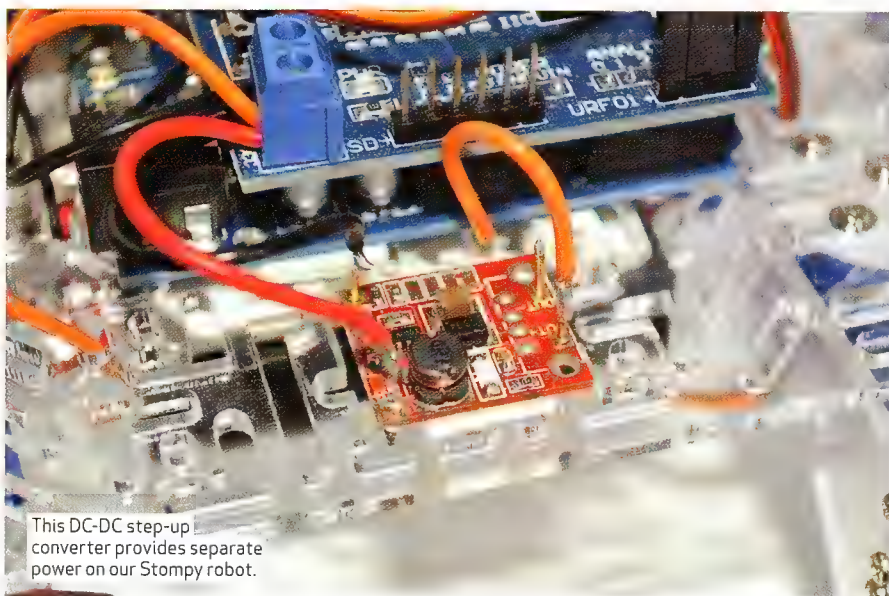
On the surface, powering an Arduino board is dead-easy – whack in a USB cable, plug it into a USB AC power brick and you're done. While it works for many projects, it doesn't suit everything, nor is it exactly 'portable' and that's where understanding how Arduino uses electrical power can make a real difference.

VOLTAGE INPUT

On their own, most Arduino boards with ATMEGA microcontrollers consume between 30 and 40milliamps (30-40mA) – and a reasonable amount of that is consumed by the on-board LEDs. But what about powering other components?

Look at any Arduino Uno or Leonardo board and they have three locations for applying power – the USB port, the 2.5mm DC socket and the Vin pin on the shield header (which connects back to the DC socket).

The USB port is designed to take in a regulated 5-volt DC voltage, which you'll get from any USB host port or USB AC power brick. But while all USB sources have the same nominal voltage, each USB port's ability to supply current will vary. Remember, current is like fuel for your car – if you try to consume more current than the USB port can supply, the DC voltage



This DC-DC step-up converter provides separate power on our Stompy robot.

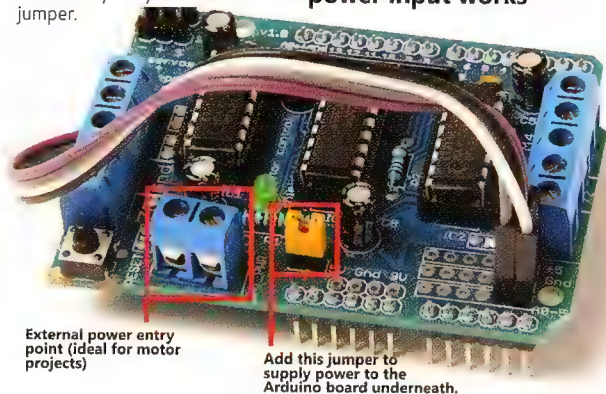
will fall and cause the Arduino board to shut down. That reduces the current consumption, the voltage rises, the board reboots, consume too much current again and get stuck in a boot loop. That's why it's vital you understand how much power your project consumes and use the appropriate power source capable of supplying sufficient current to keep it running. For example, a computer-

based USB port can only be certain of supplying 500mA max to an Arduino board. USB AC power bricks can supply up to two-amps (2A), depending on the model.

The 2.5mm DC socket is more flexible – it'll take a DC voltage over a 7-12-volt range. The reason it can is that most Arduino boards come with a linear 5VDC three-terminal regulator, whose job is to convert that voltage

The Motor Drive Shield has external power, routable by the yellow jumper.

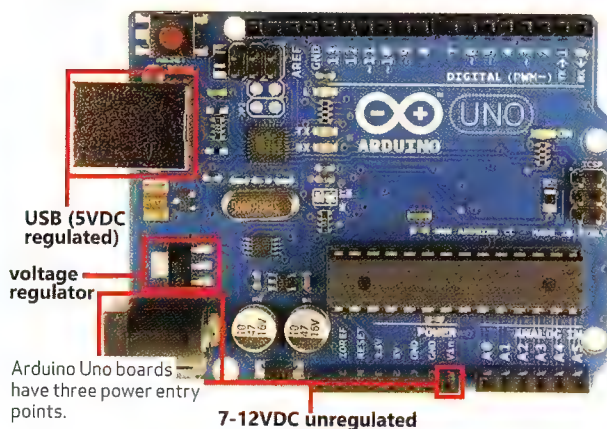
How the Motor Drive Shield power input works



External power entry point (ideal for motor projects)

Add this jumper to supply power to the Arduino board underneath.

Three electrical power entry points on the Arduino Uno



USB (5VDC regulated)

voltage regulator

Arduino Uno boards have three power entry points.

7-12VDC unregulated

9V to DC adapters are common, but only practical for very low-power projects.

This \$2 USB volt/current meter from eBay can check project power draw.

This tiny USB DC step-up converter turns one AA battery into 5VDC regulated.

Mobile power packs are another useable source for Arduino power.

range back into a regulated 5VDC for the ATMEGA controller chip.

That chip has its own allowable input voltage of between 1.8 to 5.5-volts – the higher the voltage, the faster it can run. But in most instances, the speed is regulated by an electronic component called a ‘crystal’ that locks the clock rate in most boards to 16MHz. To run at that speed, the ATMEGA chip needs 5-volts DC, which is why a 5VDC regulator is included. But, the regulator can only maintain that voltage at no more than around 800mA of current – if the rest of your project needs more than 800mA (quite likely in robot projects), chances are the regulator will be overheating and eventually fail.

POWERING MOTORS

The issue of powering your projects becomes more urgent when you start making anything involving motors – robots, quadcopters and the like. Any motor capable of producing significant movement consumes more power than you should be supplying direct from an Arduino board. The Motor Drive Shield we’ve looked at previously is a good solution – it has a two-pin terminal block for external power, plus a pin-header shunt (yellow block in the photo). With the shunt in place, power from the terminal block is connected to the Arduino’s Vin pin and its on-board regulator; remove it and you can power the Arduino board

separately, often seen as a good idea for motorised projects.

The terminal block powers the shield’s motor controller chips and the motors you connect to it, rather than having the Arduino do it – and that protects the Arduino from being overloaded (yes, this shield can only drive motors up to 1000mA, but there are more powerful alternatives).

In terms of electrical design, you always want your heavier-load components closer to the power source – think of each part of the project as links in a chain, with links that start out thick, but grow smaller as you go down the chain. The Arduino board itself is a small link and should only power devices that are even smaller links in terms of their power draw.

POSSIBLE POWER SOURCES

Arduino is a popular choice for battery-powered projects, but most Arduino boards aren’t really designed to handle batteries. More recent microcontroller/processor boards have built-in monitoring and charging circuitry for 3.7-volt Lithium-ion/polymer batteries. CHIP, the new \$9 computer (tinyurl.com/onqqech), is a good example – not only does it have that monitoring/charging circuitry, a key reason why CHIP can handle these batteries is that, like many recent chips, it runs off 3.3VDC. Using these batteries on most Arduino boards is more complicated because of

the Arduino’s need for 5VDC, rather than 3.3VDC.

One solution that’s common is to use a 9-volt battery clip to DC connector adapter – you can buy these on eBay for under \$2 and for very low-power projects, it’ll do. But remember, 9-volt PP3 batteries have very low capacity and aren’t designed to supply more than around 40mA – certainly not enough to run a couple of robot motors.

Get creative and there are other solutions – such as a low-cost USB emergency power pack. This takes two AA-sized cells and via a built-in DC-DC converter, increases the cells’ combined 2.4/3VDC voltage into a (somewhat) regulated 5-volt output on a USB host port, usually good for up to 1000mA. But you can also buy the DC-DC converter board on its own and get even more creative with your power source – hand-crank power generators, other sub-5VDC battery packs or even solar cells. Both converter options you’ll find on eBay for around \$2.

The idea of combining the DC-DC step-up converter with a 3.7-volt Lithium-ion battery isn’t new, however – that’s the recipe for virtually every mobile power pack. These supply 5VDC power via USB host port up to around 1000mA. However, they’re not necessarily ideal for outdoor projects that should be weatherproofed. Still, the proliferation of these power packs means they’re as cheap as chips from many online retailers.

BE WISE WITH YOUR POWER

The key to power is using it wisely – and that’s just as true with Arduino projects. Always ensure your power source is capable of providing the current your project needs and that requires you understand how your project works and the likely current drain during its operation.

Building your own tech gear is incredibly satisfying because you know better than anyone how it works – and how to fix it. Powering it with the right power source will ensure it always performs at its optimum. ■

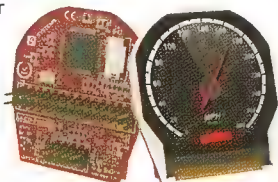
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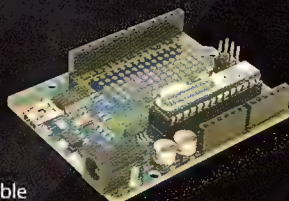


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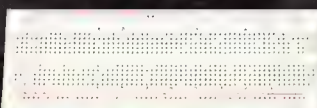
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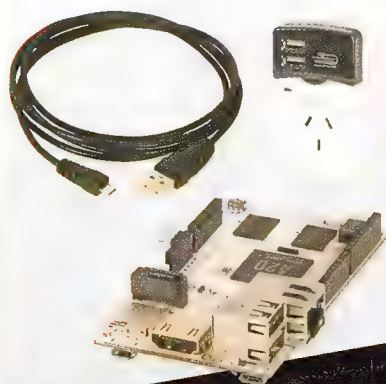


PcDunio is essentially a modern personal computer on a compact board with lots of input and output. Blindingly fast, extremely flexible and hugely powerful, it comes with an onboard SATA port pre-loaded with Ubuntu Linux and XBMC Media Centre, which can be replaced by Android OS. See below for more specs.

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Available in Nano and Wi-Fi to suit your own personalised project.

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	XC-4352 PCDUINO NANO	XC-4350 PCDUINO WI-FI
SoC	All Winner A20	All Winner A20
CPU	1GHz, ARM Cortex A7 Dual Core	1GHz, ARM Cortex A7 Dual Core
GPU	OpenGL ES2.0, OpenVG 1.1, Mali 400 core	OpenGL ES2.0, OpenVG 1.1, Mali 400 core
SDRAM	1GB	1GB
Flash Memory	4GB Flash	4GB Flash
Memory Expansion	microSD up to 32GB	microSD up to 32GB
Video Connection	HDMI 1.4	HDMI 1.4, LVDS
Audio Output	3.5mm Analogue	3.5mm Analogue, I2S Stereo Digital
Onboard OS	Ubuntu 12.04	Ubuntu 12.04
Supported OS	Android 4.2 (ICS) / Linux 3.0	Android 4.2 (ICS) / Linux 3.0
Extension Interface	Arduino	Arduino
Network Interface	10M/100Mbps/1Gbps	10M/100Mbps/1Gbps, Built-in Wi-Fi
USB Ports	2 x USB 2.0 & 1 x USB OTG	1 x USB 2.0 & 1 x USB OTG
SATA	SATA Host Socket	SATA Host Socket
Power	5V, 2000mA	5V, 2000mA
Size	96 x 60mm	121 x 65mm
RRP	\$89.95	\$119.00

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This book is aimed at those who have already had some basic experience in electronics. The function and behaviour of the major electronic components are well covered in this book. The skill and experience level required for these projects ranges from absolute beginner, to hobbyist-expert.

- Soft cover, 260 pages

**New
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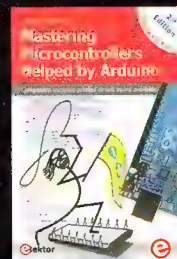
MASTERING MICROCONTROLLER HELPED BY ARDUINO

BM-7144 \$69.95

In this book theory is put into practice on an Arduino board using the Arduino programming environment. After completing this fun and playful course, you will be able to program any microcontroller, tackling and mastering I/O, memory, interrupts and more. All programs presented can be downloaded for free from www.elektor.com/mastering-microcontrollers.

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Drawing shapes in GUI apps

The ability to draw graphics is key in any GUI programming language. Darren Yates shows you how to implement Java graphics, including Mandelbrot fractal animations.

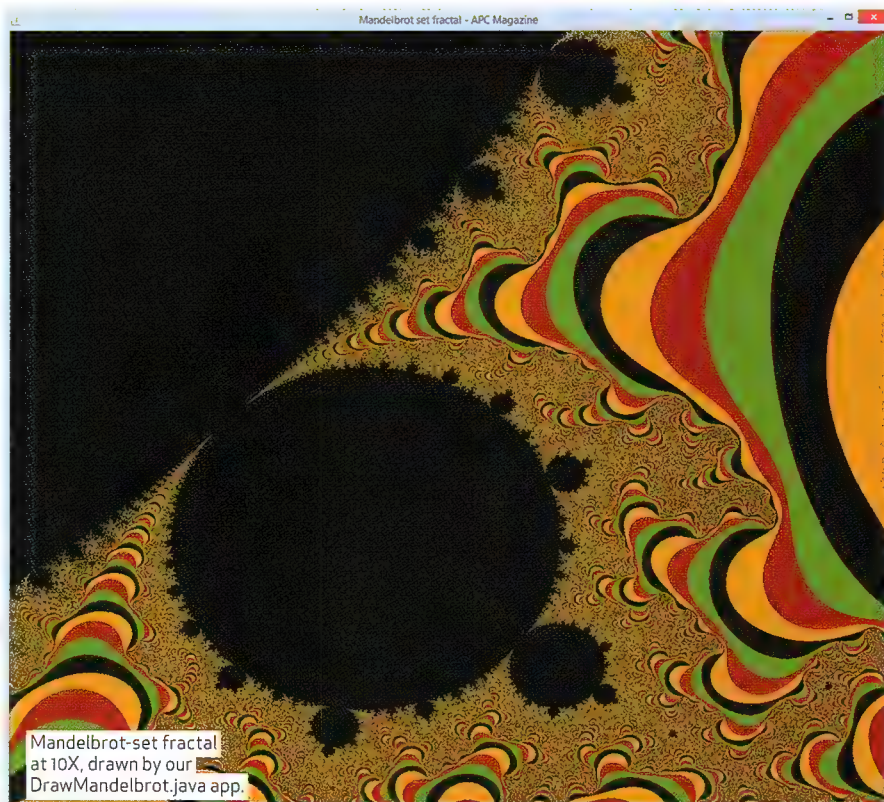
Sooner or later, you get to the point in your coding travels where you need to draw shapes and images. We've already had a brief look at how to display images in Java, but this month, we'll look at how to draw 2D shapes.

Java has many graphics functions from drawing lines, ovals, rectangles, polygons – you can also create rounded-corner rectangles, sets colours and fill them in. One thing all Java drawing commands have in common, though, is the coordinate system, the two-dimension map of pixels that defines where within a frame or panel your shape will appear. For Java, the top-left corner is origin, written as (0,0), with the first number being the X- or horizontal-axis coordinate and the second, the Y-axis. Most Java commands require at least four parameters – the X- and Y-axis starting points, followed by the X-axis and Y-axis length. But so as to find out the size of the frame you're drawing in, Java provides two commands – `getWidth()` and `getHeight()`, which return the horizontal and vertical frame size, respectively, in pixels as integers (which we'll use in a moment).

DRAWING A SQUARE

OK, enough talk – let's draw something! Head to our web site and download this month's Java programming pack from apcmag.com/magstuff. Unzip it and you'll find four further zip packages. Open the NetBeans IDE (get it from tinyurl.com/nqnuxfp), choose 'File > Import Project > From ZIP' and select `DrawSquare.zip`. You can see from the code here that there's not too much to it. We start by creating a class called 'DrawSquare' that extends the basic `JFrame` class – this means our class will do or 'inherits' everything a `JFrame` can do, plus whatever else we code. Inside the `main()` method, we create a `DrawSquare` object called 'frame', set the frame size to 800 x 600-pixels, centre it and make it visible.

The '`public DrawSquare()`' command is the class constructor for our `DrawSquare` class and it only has one command – to add a new 'PanelSquare' object to the frame. What's a `PanelSquare` object? The last part of the code tells us – it's actually another



Simple GUI app for drawing a square

```
package drawsquare;

import java.awt.*;
import javax.swing.*;

public class DrawSquare extends JFrame {

    public static void main(String[] args) {
        DrawSquare frame = new DrawSquare();
        frame.setSize(800,600);
        frame.setTitle("How to draw a square - APC Magazine");
        frame.setLocationRelativeTo(null);
        frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
        frame.setVisible(true);
    }

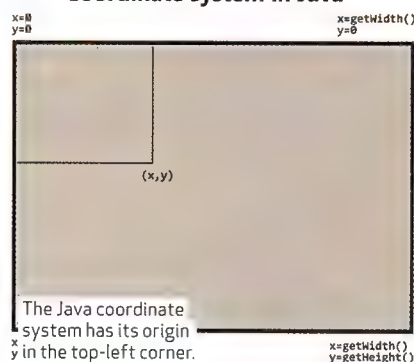
    public DrawSquare() {
        add(new PanelSquare());
    }
}

class PanelSquare extends JPanel {
    @Override
    protected void paintComponent(Graphics g) {
        super.paintComponent(g);
        g.drawRect(200,75,400,400);
    }
}
```

The complete code for `add(new PanelSquare());` a simple app to draw a square on a `JFrame`.

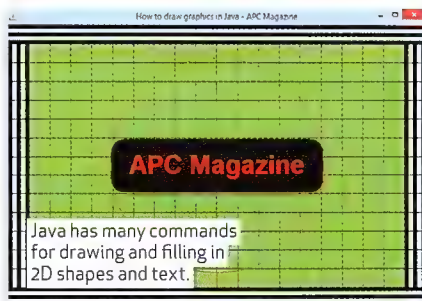
class, but this time it extends `JPanel`. `JPanels` are great because they automatically implement the `paintComponent` method Java uses to draw stuff. Instead here, we're 'overriding' it. Overriding is a cool feature that allows you to replace existing Java methods with your own. However, we still want the 'parent' `JPanel`'s `paintComponent()` method to do its thing first, so we start with the '`super.paintComponent(g)`' method,

Coordinate system in Java



where the 'super' refers to the parent or 'super'-class.

After that, we're ready to draw the square using the `g.drawRect()` method – the first numbers set the starting coordinates to (200,75) and the length and height of the square are both set to 400-pixels. And that's it. It's not the only way to draw in Java but we'll follow this method of app construction in our remaining apps this month.



DRAWING MULTIPLE GRAPHICS

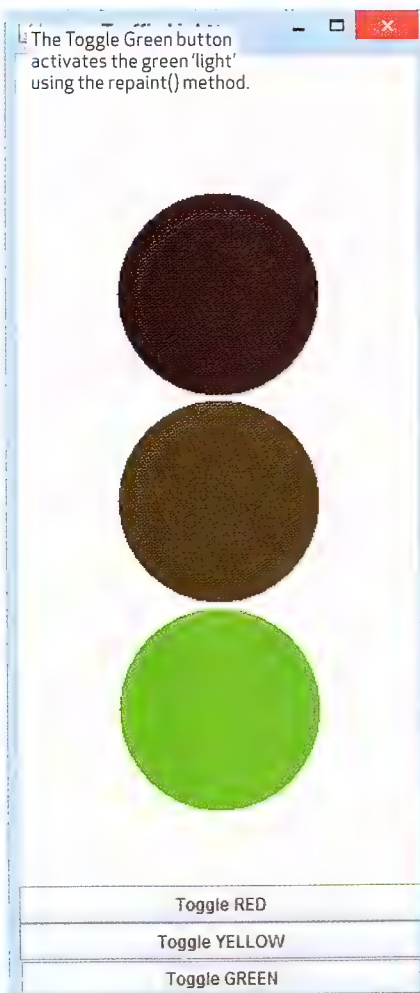
You can implement multiple drawing commands into one app or method, as you can see in the `BasicGraphics.java` app. I'm clearly no Renoir, but most business graphics are more mathematical than impressionist! Again, we follow the same code construction as before, creating a class that extends `JFrame`, another that extends `JPanel` and draw our shapes in the `paintComponent()` method.

But this time, let's add some more variety – for starters, you can change colours by using the `g.setColor()` method and either Java colour constants such as `Color.red` or `Color.green`, or create your own colours with the 'new `Color(r,g,b)`' class, where the colour is created from three 8-bit (0 to 255) numbers representing the red, green and blue components. Using for-loops with set intervals, you can create your own grid patterns (a great way for starting your own graphs and charts). You can even draw text or 'strings' using the `g.drawString()` method as well as setting your own font. Fonts are applied by first setting the parameters of the `g.setFont()` method, which consists of the font name as a string, the font type (bold, plain, italics) as a Java constant and the font size as an integer.

INTERACTING WITH GRAPHICS

Drawing graphics at the launch of your app is fine, but you can also change your graphics on the run using the `repaint()` method. Used with a `JPanel` or extended class object, you can force that panel to redraw at any time – usually right after you've made a change to the screen. Launch the `TrafficLights.java` app and you'll see three 'lights' with three `JButtons` underneath. Press the 'Toggle red' button and the red light will light up and turn off again alternately. Same thing happens with the 'Toggle yellow' and 'Toggle green' buttons.

The `JButtons` work here as we've seen them previously – each button has an `ActionListener` attached to it (in this case, all three are anonymous, meaning they have no specific name, just 'new `ActionListener`'). Inside each `ActionListener`, we have a boolean (true or false) variable, red, yellow or green,



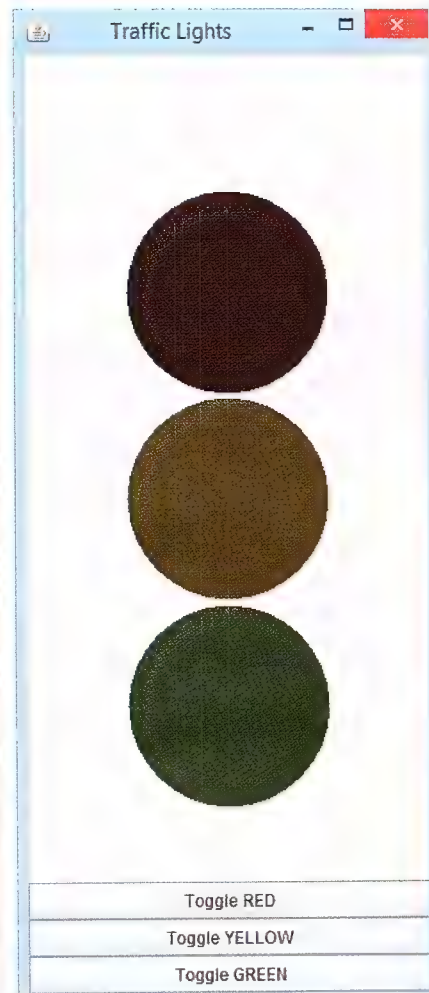
and what we do with it is simply invert its value, by making it equal to its opposite (we 'NOT' it, if you're familiar with digital logic) through the exclamation-mark (!) symbol. So for example, if the value of the 'red' boolean variable is 'true', 'red' means take the opposite value, which is false, and assign that to the red variable. Same occurs if the red value starts as false.

The other command in each `ActionListener` is the `repaint()` command – this tells Java to run the `PanelLights.paintComponent()` method.

The first trick here is that the three boolean variables – red, yellow, green – are set as class variables, meaning any method or subclass within the `TrafficLights` class can see them. You'll notice the following code fragment in the `paintComponent()` method:

```
if (red) g.setColor(onRed);
else g.setColor(offRed);
g.fillOval(startX,startY,lightDiameter,lightDiameter);
```

The first line says if red is true (you don't need to include the '== true' bit to test for boolean 'true'), set the graphics colour to 'onRed'. Go to the start of the

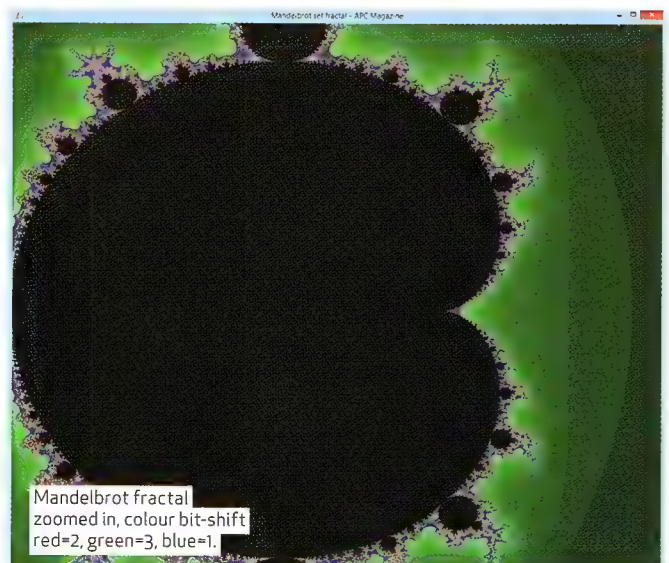
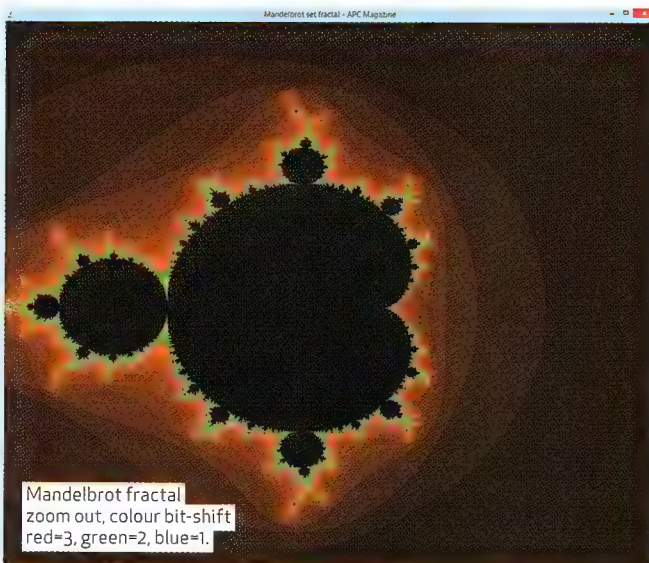
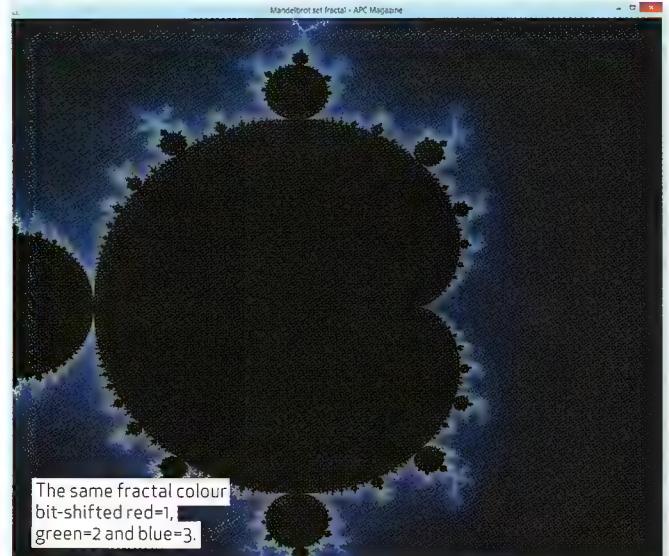


`PanelLights` class and you'll see we have six defined colours. Note the two for 'onRed' and 'offRed' – the `onRed` colour has a red value of 224, the `offRed` has a value of 48. The higher the number the brighter the colour, so if the 'red' variable has the value 'true', we set the colour to the bright (on) level; otherwise, we set it to the `offRed` colour, which is darker.

After that, the `g.fillOval()` method draws the 'light' using the supplied parameters, which basically ensure we're drawing the red light at the right location and at the right size.

Again, notice the app follows the same basic pattern – there's a fair bit more going on in this one, but it's still a case of creating a class that extends the `JFrame` class, create another to extend a `JPanel`, then getting the `JFrame` constructor to add the `JPanel` to the `JFrame` and using the `JPanel`'s `PaintComponent(g)` method to do the drawing.

One more thing, try clicking and dragging a corner of the app frame and you'll see the lights not only move but also overlap – the key here is that subsequent drawing commands are drawn over the top of previous ones – something to remember when you're working out your code.



MANDELBROT FRACTAL ANIMATION

And to finish off this month's coding, we'll push our knowledge a bit, by combining a new Java class in with some mind-twisting mathematics to create a looping Mandelbrot fractal animation. You've no doubt seen these crazy looking squiggles before, but not necessarily how they're generated. That's what our DrawMandelbrot.java app does.

In really simple terms, fractals are self-repeating geometric patterns – no matter how far you zoom into the pattern, you see (usually something very close to) a copy of what you saw before. The fractal we're drawing here is based on the common 'Mandelbrot set', named after French mathematician Benoit Mandelbrot. The set is built from the quadratic equation:

$$z_{n+1} = z_n^2 + c$$

Where C is a complex number that remains 'bounded', meaning that for each iteration, the number remains with a confined number space and doesn't splay off to infinity. Complex numbers can be hard to get your head around but they're numbers that have a 'real' and 'imaginary' part.

They're commonly used in advanced mathematics and electrical engineering – the imaginary bit is the solution to $i^2 = -1$, or the square-root of minus-one.

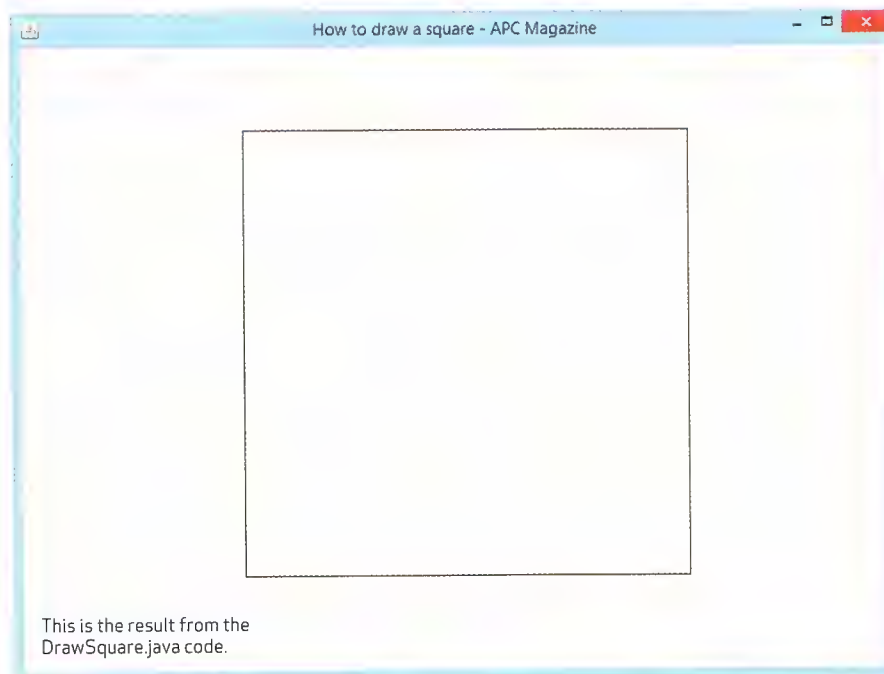
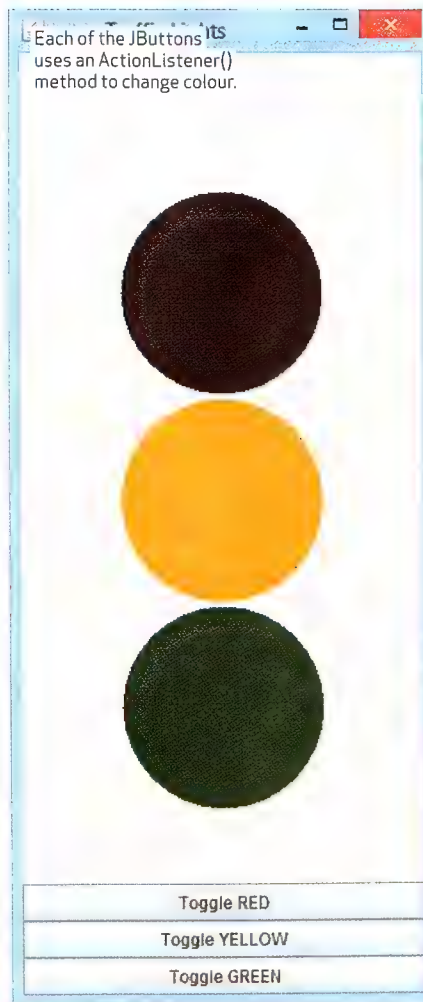
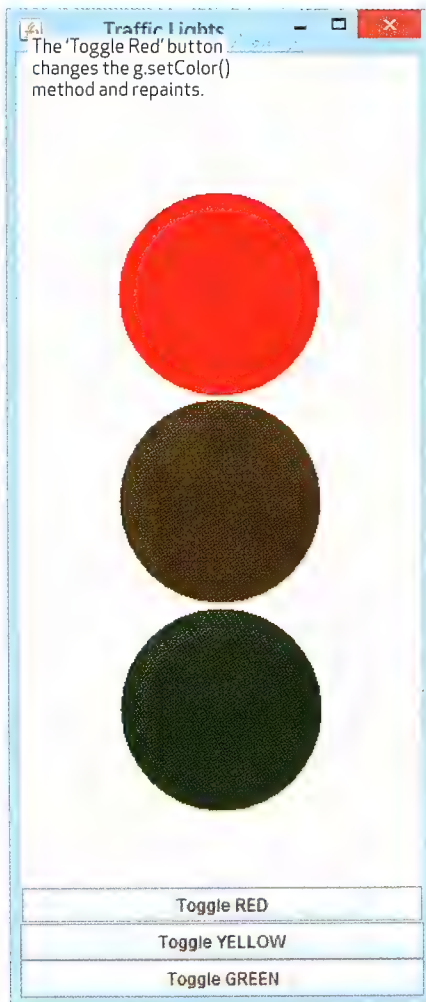
Engineers use it in everything from advanced electrical power control to digital signal processing (DSP) and Fast Fourier Transforms (FFTs).

OK, let's get back on-topic. Again, our DrawMandelbrot.java app isn't the most efficient way to draw a Mandelbrot fractal, for sure, but it follows the same process we've been using this month of JFrame extension and JPanel implementation, so you can get more of a handle on what's going on.

DRAWMANDELBROT CONSTRUCTOR

First, take a look at the constructor for the DrawMandelbrot class ('public DrawMandelbrot()') – the first three lines should be familiar: we set up the layout manager, create a panel object from the PanelMandel class and add it to the frame. After that, we add in a new ActionListener, but instead of attaching it to a JButton as we've done previously, we attach it to a Timer object.

The Timer class is a simple class that enables you to repeatedly launch an ActionListener after a set time period has passed – you can see it here in the last two lines of this constructor. We start by creating the Timer object called 'timer', then set the time delay (in milliseconds) to 250, followed by the name of the ActionListener we want to run at the end of each time period (in this case 'updateMandel'). Next, we start the timer. And that's it – you can stop the timer elsewhere in your code



and do other things, but for now, just know that Timers are really useful and easy to implement in Java.

PANELMANDEL CLASS

Similar to before, PanelMandel extends the JPanel class and we use

this to draw in. Now there's nothing too original about the way we're creating the fractal image here — this is a fairly common algorithm where we draw in the fractal one pixel at a time. We calculate the complex number C by setting the horizontal axis as the real

(constReal) and the vertical as the imaginary (constImag) parts in two nested for-loops. We then implement the quadratic equation and based on when the result becomes four or greater and the number of iterations is reached, we then set the colour of that pixel to draw. Finally, we draw the pixel using the `g.drawRect()` function with the `x`- and `y`-axis size of the 'Rect' set to zero to give us a single pixel or point.

The real trick to this way of drawing fractals is setting the pixel colour with the code line:

```
g.setColor(new Color((curIter
<< 6) % 255, (curIter << 7) %
255,0));
```

If the while-loop didn't reach its maximum iteration count, we set the colour by performing some bit-wise shuffling of the current value of the iteration variable 'curIter'. The double-left arrows '<<' mean we're taking the curIter number as a binary and shifting its bits left by the number indicated after the arrows.

Remember that the Color class takes three eight-bit numbers (0 to 255) to create the red, green and blue components. By shifting the bits of the 'curIter' number left, we're making the number larger — the first is shifted six bits, the second by seven (we set the blue component to zero in this case). It's essentially a fancy and fast way of performing bit-multiplication.

Finally, these numbers are then taken as modulo (%) 255 to ensure we only get end results that are between 0 and 255, as required by the Color() class. The final output is the red, green, yellow and black fractal, which is quite striking. The way you vary this 'bit-shifting' changes the fractal colour — for example, bit-shift red by one, green by two and blue by three gives a ghostly 'night-time' fractal.

The animation is created by the timer, which increments the maximum iterations and redraws the JPanel every 250-milliseconds. Once the current-iteration variable reaches the maximum setting, it reverts to zero and starts again, continuously looping the animation. When you run the app for the first time, it'll take a couple of seconds for the first pixels to appear, so give it time (particularly if running this on an older computer).

GIVE IT A GO

You probably won't have that much call to code fractals into your GUI apps, but it's a fun way to see how Java, like almost any GUI-ready programming language, can combine mathematics with drawing and add interesting graphics to your apps with surprisingly few lines of code. ■

downtime

EDITED BY TRACY EMMAN

apc
RECOMMENDS

Thought Batman had a hard time in *Arkham City*? Just wait until *Knight's* Halloween is through.



FORM \$79 | PC, PS4, X1 | WWW.BATMANARKHAMKNIGHT.COM

Batman: Arkham Knight

Overburdened with features, but still the best Batman fantasy yet.

Batman: *Arkham Knight* is a brash attention-hungry action game, but it's at its best when nothing is happening. Gliding through the depressed, rain-sodden streets of Gotham is arguably this series finale's richest experience, and with his new batsuit, Bruce Wayne can move through the dark dystopia with grace and finesse. As far as video game worlds go, Gotham is among the most beautiful and atmospheric hellscapes ever made: it's a broken, evacuated city, but you never feel like you want to join the exodus.

If you loved the previous games in the series, or if you just love Batman, you'll already have played and probably completed *Arkham Knight*. It's undeniably polished, and the Batman power fantasy has never felt better than it

does here. Picking up after the previous game, Joker is emphatically dead (he's cremated in the very first scene in the game), but now Gotham has another foe to contend with in the form of the mysterious 'Arkham Knight'. The city has been evacuated, Scarecrow's meatheaded underlings are roaming the streets for violent distractions, and the series' fresh mix of puzzle solving, stealth and head punching is all intact.

The last thing anyone ever asked of a *Batman* game is tank warfare though, but inexplicably, that's the major new feature Rocksteady has ushered in with *Arkham Knight*. Game audiences want novelty (under the guise of 'innovation'), but it's rare for a new feature to be as tone deaf as *Arkham Knight's* Batmobile, which disrupts the oddly meditative pace of the previous games in the series. Cruising around in the Batmobile is fun, but not as

fun as swooping quietly through the streets. Meanwhile, the Batmobile's tank combat setting — which activates strafing and weapons — is well executed but an unwelcome change of pace. I dreaded every wheeled combat scenario, but the game keeps them coming thick and fast.

The Batmobile isn't used solely for combat and tearing chunks off Gotham tenement buildings at high speed. You can use a winch to manipulate the game world, and you'll be regularly called upon to use this feature in *Arkham Knight's* puzzle scenarios, where Batman's ability to control the vehicle remotely comes in handy.

While the Batmobile is hit and miss and the other staple gameplay elements orthodox, *Arkham Knight* really nails storytelling and presentation. It's hard to convey without spoiling certain plot beats, but the

way *Arkham Knight* melds cinematic moments with exploration cements Rocksteady as a master of video game storytelling: no easy task in an open world game. It's a shame then, that the final *Arkham* outing is marred with an overburden of features: in addition to the Batmobile, Batman's array of tools and attack combos consistently put the player at the bottom of a learning curve. Despite its shortcomings though, *Arkham Knight* will be remembered for its atmosphere and roleplaying. Whether you love the Batman fantasy or not, it's difficult to resist the pull of this bleak city.

■ Shaun Prescott

Verdict

One of the most engaging open worlds for some time, but it's marred by an overreliance on the Batmobile.



apc
RECOMMENDS

Take that, priceless Egyptian statue collection!

FREE | PC | WWW.BATTLE.NET

Heroes of the Storm

A bridge-building ambassador for its genre.

Let's start by saying this is not just another multiplayer online battle arena. It's a comment on the MOBA itself, by the company whose games inspired the genre. This is a studio that's always valued accessibility, a belief strengthened of late by the striking success of *Hearthstone*. As such, *Heroes of the Storm* is a MOBA for people who don't play MOBAs.

It'll be divisive, that's for sure. In designing *Heroes*, Blizzard has stripped away many of the ideas that previously defined the genre. Individual levelling is gone, replaced with a team-wide experience bar. Gold is gone, and with it items that boost your character's powers. Strategic drafting is gone, at least until you complete the long climb to competitive ranked play. For the majority of players, *Heroes* is a game where you pick who you want to play, click 'Play', and play.

Doing so places you in a

team of five fantasy heroes drawn from Blizzard's wide roster. Victory means pushing AI-controlled creeps from one side of the map to another along linear lanes. This means passing through the gateways, towers and fortresses that amount to your opponent's outer defences, and when one team's core falls, the game is over. Here the comparisons to other MOBAs end.

There are seven maps at present, each of which offers a different layout and set of objectives. In *Sky Temple*, capturing shrines and defeating guardians grants your team a building-felling laser weapon. In *Blackheart's Bay*, collecting coins for a ghostly pirate allows you to turn his cannons on your enemy. In *Haunted Mines*, the titular caverns amount to a side-dungeon where you gather undead skulls to power up your hulking golem.

It often feels like entering a *Dota 2* match in the middle,

and within 15 minutes you can be playing out battle scenarios that would amount to the endgame of a 50-minute epic elsewhere.

These scenarios are likely thanks to a generous number of comeback systems. Games rarely feel lost within the first few minutes. Teams that are behind receive bonus experience, and the plurality of objectives means there's almost always something you can do to turn your fortunes around.

These decisions make *Heroes of the Storm* the most accessible MOBA we've played. They amount to a striking simplification of the genre's vocabulary, boiling the most opaque sector of competitive gaming to a handful of verbs: attack, defend, capture, collect. It opens up the basic strategic pleasure of five-on-five fantasy battle to an audience that might never have tried it. As much as it truncates the genre, *Heroes* preserves strategic concepts that are

more advanced than those it's removed. Blizzard has created a game entirely about map control, timing, momentum, and combat finesse.

In some ways, we feel more comfortable recommending *Heroes* than we do *Dota 2*. This is because Blizzard has created a MOBA that doesn't require you to commit your life, or even an entire week, to get something from it. The benefit for newcomers is obvious. The benefit for existing MOBA players is more subtle. We finally have a fit ambassador for the genre, and we hope it's the game that shows people who don't like MOBAs what they're missing.

Chris Thursten

Verdict

The most any studio has done to open up a complex genre to a new audience; inviting and entertaining.





US\$49.99 | PC | WWW.GALCIV3.COM

Galactic Civilizations III

Shoots for the moon, if not yet the stars.

GalCiv 3 doesn't so much pick up where the last game left off as return to its template with a stern expression, better technology, and a few years of lessons well learned.

The series is almost unique in the 4X genre: a space conquest game that's not just a game of rules and strategy, but of quirky charm. Witty descriptions take the harsh edge off the technologies, there's an attempt to make the aliens feel like they have personalities instead of simply a rendered face over some stats, and there's enough wrapping to suggest there could actually be people somewhere behind your comma-filled population figures.

Aside from graphical polish, the two biggest differences between this version and the last are that *GalCiv 3* now supports multiplayer and demands 64-bit. The latter is interesting in that it means future expansions and player mods have far more room to breathe than they once did, which bodes well.

BACK INTO SPACE

The core game is extremely solid. Playing against the AI feels like being up against opponents rather than simply algorithms. Where so many 4X games, particularly space ones, are almost wilfully cold, there's a warmth to *GalCiv* that is key to the fun of casual to at least mid-tier play.

A few irritations strike midway through, such as the difficulty of finding out what's actually wrong with a planet that should be performing better than it is, and of otherwise tracking down numbers in a pinch. By the time you've got a sprawling empire, there's enough data splashing around to drown in. Individual sections are very well laid out, with the tech tree especially making it easy to see what leads to what and what the benefits are, but you feel the lack of a good centralised in-game Civpedia.

The biggest omission from the last game — for now — is that the political side has been stripped down. No elections, no governments, no spying. They're due to return in a later expansion. The sting

"Where so many 4X games, particularly space ones, are almost wilfully cold, there's a warmth to *GalCiv* that is key to the fun of casual to at least mid-tier play."

is taken out of that by a few new arrivals, such as ideologies. Where past games had a good/evil system, civilisations this time are judged as Malevolent, Pragmatic and Beneficial, with moral decisions providing points in each that can be cashed-in for special perks. These range from a free colony ship or a top-quality planet, to galaxy-affecting boosts. Other new additions include pirate bases that become more of a problem the longer they're left alone, a shift to space-based ship construction, and new environmental dangers to deal with while exploring the map.

You don't get any direct control over your ships, instead they're classed by

their loadout. A basic hull might be a Guardian, but slap life-support on it and it becomes a Support. Its role determines what it does and who it goes after in combat.

Whether you're new to the series or returning, *GalCiv 3* is easily the best recent 4X of this scale — the whole galaxy as campaign and sandbox. It's hardly the most dramatic upgrade, but it's more than solid, and a great base for expansions and mods for the next few years. ■ Richard Cobbett

Verdict

More of a refresh of the last game, but it's still hands-down the best modern way to conquer unknown space.





US\$14.99 | PC | WWW.MAGICKA2.COM

Magicka 2

Conjuring up another round of great co-op adventuring.

If you loved *Magicka* and can't wait for more, here is a one-paragraph review for you:

Magicka 2 is faster, slimmed-down, and just as brutal. Changes to the spell system rob the advanced spells of their most potent powers, but make them easier to wield. It is absolutely unplayable as a singleplayer game, but two friends can blow through the main story in an afternoon. Now go play it.

If you've never played *Magicka*, you're missing out on an irreverent, slapstick wizard adventure grafted onto one of the most genius combat systems ever devised. Viewing things from a top-down perspective, players control wizards by joining any five of eight elements and casting them on others, themselves, their swords, or on the ground around them. Multiplying these eight variables by the four ways to cast them yields tens of thousands of spell combinations, each with its own effect.

Shield and rock cast together can create either a slab wall between you and your enemies or a suit of rocky armour, depending on

the circumstances. Add fire and rock to throw a fireball. Mix frost, water, and death magic to shoot a spray of poisoned ice shards. It goes on and on, and experimentation is the only way to discover great combinations.

Magicka 2's biggest change is to strip down the first game's most powerful special spells to a few essentials and assign them to a cooldown hotbar.

It's a change that will upset a lot of *Magicka 1*'s biggest fans, but I think it's an acceptable compromise between difficulty and accessibility.

Speaking of difficulty: don't play alone. Without a friend to resurrect you, you're forced into a defensive playstyle that the level design deliberately disrupts. Playing alone also keeps you from crossing beams and chaining explosions with friends: the most powerful spells aren't accessible to the lonely wizard.

With friends, the freewheeling, aggressive style *Magicka* is known for shines through. Any good boss fight saw my party resurrect itself many, many times, accepting casualties

as the cost of doing wizardly business. We beat the main campaign on normal in less than four hours. That's pretty short, but factor in the multiple ways to replay levels in challenge mode, and *Magicka 2* offers a ton of replayability in a tight, economical package.

And unlike *Magicka 1*, with its infamously buggy launch, *Magicka 2* is stable as a rock. I noticed the odd animation glitch here and there, but my party and I never had problems with dropped connections or lag. Beyond stability, however, the PC port is pretty basic. There's no way to rebind keys, and in-game button prompts all feature PlayStation 4 control schemes.

For the most part, *Magicka 2* is *Magicka 1* done over again, in a more polished, streamlined, bite-size package.

■ Ian Birnbaum

Verdict

A leaner, smarter take on *Magicka*'s fascinating combat system, this is the co-op game you've been waiting for.



Farming Simulator 15

Old MacDonald would be unimpressed.

FROM \$28 | PC, XBI, X360, PS4, PS3 | WWW.FARMING-SIMULATOR.COM

Apparently 'gamers who wanted their own agricultural freehold when they grew up' is a bigger demographic than anyone realised. This is *Giants*' fifth foray into farming simulation, and it's not actually that bad, if what you're looking for in a game is driving over fields at ten miles an hour, and owning a lot of unproductive hens.

It's clear that a lot of attention to detail has gone into the various bits of farm-based machinery with which you cultivate and harvest crops, but you get the nagging feeling that not much went into everything else. There's a frustrating glitch that can make hitching your tractor to trailers a chore, the controls are complex and unwieldy and the only way to fast travel across the pretty sizeable map is to teleport between your tractors like a rural mutant who never found Professor Xavier. The driving physics are odd, the tutorials are unhelpful, the menus are hard to navigate and the list of nagging issues goes on...

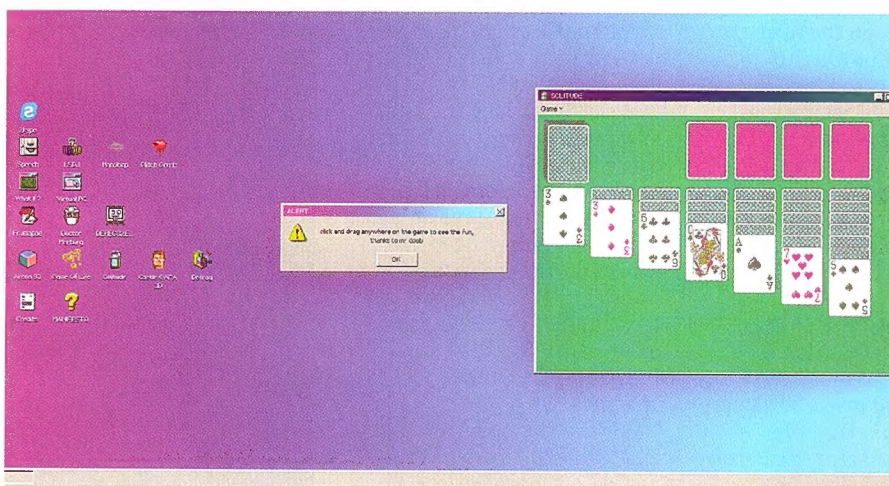
And yet *Farming Simulator 15* does have some charm to its agricultural offerings. There's a surprising variety of ways to earn your crust as a farmer, and driving determinedly back and forth is oddly calming. Hypnotic, almost. The farmer doesn't eat. The farmer doesn't sleep. He just ploughs on into the night, because the farm is a living beast and its needs must be met. Then you realise that you've been driving across the same square of virtual earth for half of a real-life hour, and you feel empty inside. ■ Alice Bell



Singing star gets sliced by drone

Enrique Iglesias learns not to mess with flying drones the hard way.

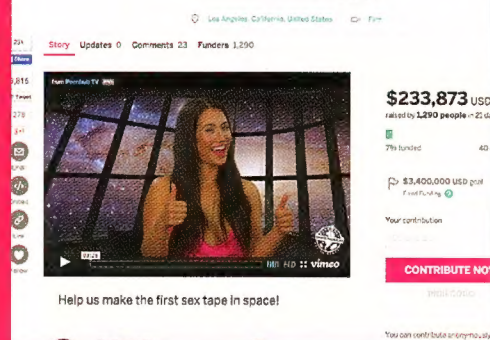
Pop sensation Enrique Iglesias was left bloodied on stage after grabbing a drone mid-flight during one of his recent concerts. The accident at a performance in Tijuana, Mexico, left Iglesias with sliced fingers after he reached out for a drone that was filming the audience. Fortunately for Iglesias, he didn't completely sever his fingers, and continued the performance for another 30 minutes, albeit with a blood-stained T-shirt. Iglesias' representatives released a statement, saying: "During the show a drone is used to get crowd shots and some nights Enrique grabs the drone to give the audience a point-of-view shot. Something went wrong and he had an accident."



FORGET WINDOWS 10 — YOU NEED WINDOWS 93 A MID-YEAR'S LOW RESOLUTION.

Feel like modern life is a little too modern? Turn your browser to windows93.net and be prepared for a click on the very bizarre side. This made-up OS (which inexplicably begins with the PlayStation 1 start-up audio blast, despite its Windows 95 motif) pokes fun at 21st century systems, with a desktop full of mostly fun (the GIF creator and the ASCII recreation of *Star Wars: Episode IV* are our picks) and/or horrifying (Hydra.exe can burn) finds. Where did it come from? We're not sure. It hasn't been designed to be practical, but it's a welcome diversion. Let us know how far you get in the bank robbery text adventure, 'Robby'.

Pornhub Space Program - SEXPLORATION



An astronomical endeavour

PORNHUB AIMS FOR THE STARS, WANTS TO SHOOT A SEX SCENE IN SPACE.

Ever wondered what the act of intercourse would be like in space? Pornographic web site Pornhub knows it's possible, and wants to find out, er, first hand. The site has set up an Indiegogo page to fund its 'Sexploration' (their title), whereby they'd send two actors beyond the stratosphere and shoot an outer-space sextape. The cost: a cool US\$3.4M. As it says on the crowdfunding page, "We will not only be changing the face of the adult industry, we will also be chronicling how a core component of human life operates while in orbit." Pledges run from as little as \$1 for a certificate of endorsement, right up to \$150,000 for one of the two spacesuits worn by the actors (presumably briefly).

The definition of old-school cool

30-YEAR OLD COMMODORE AMIGA STILL RUNNING SCHOOL AIR-CONDITIONING.

A decades-old Commodore Amiga is still being used to control the heating and air-conditioning for 19 public schools in Grand Rapids, Michigan. The machine has been running 24 hours a day since it was installed in the mid 1980s, and the software used to run the systems is maintained by the ex-high-school student who originally programmed it. As you'd expect, parts are becoming increasingly hard to come by for the Amiga, though miraculously it's only on its second mouse and third monitor. What keeps it in operation (apart from a shoe-string budget) is a 1200-bit modem and a system that incorporates radio frequencies sent to each school building.

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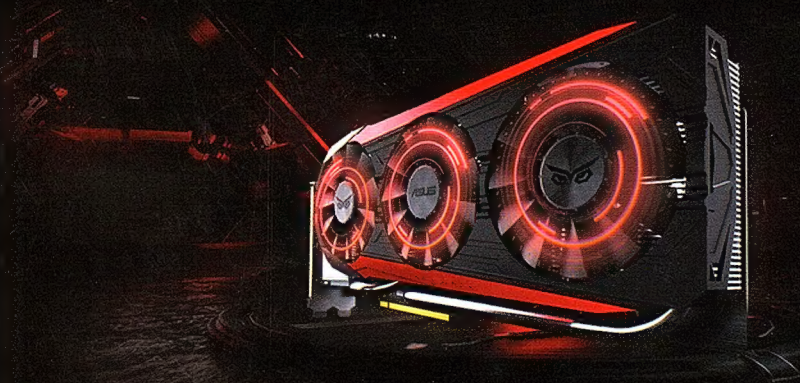
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Welcome ASUS STRIX Radeon 300-series

Welcome the new range of ASUS STRIX Radeon 300-series graphics cards, featuring the established AMD Graphics Core Next (GCN) microarchitecture. Backed by the proven ASUS STRIX feature set, including OdB Fan Technology delivering quiet gaming like never before, the new range of STRIX Radeon 300-series graphics cards deliver strong pixel pushing power!



The new range of STRIX Radeon graphics cards covers the whole Radeon 300-series range from the STRIX R7 360 through to the STRIX R9 390X starring the new DirectCU III heatsink solution, the successor to the renowned DirectCU II. The new range also implements new manufacturing technology in the form of Auto-Extreme Technology.

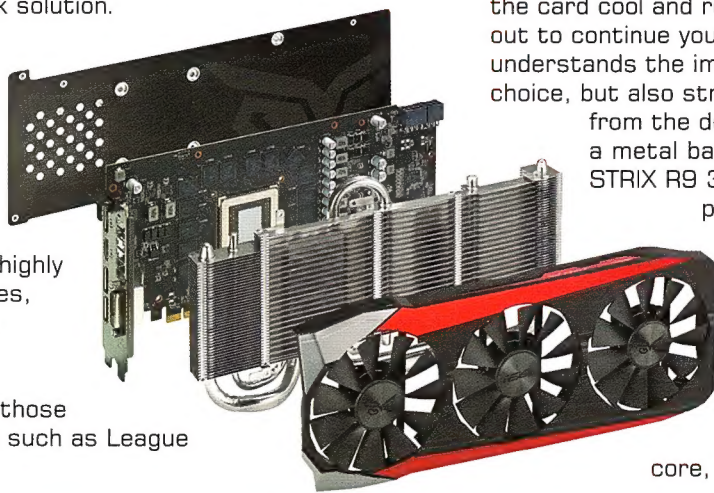
But what is the new DirectCU III heatsink solution and Auto-Extreme Technology all about? Read on to learn more!

Stay Cool with DirectCU III

The STRIX R9 390X delivers the next generation of DirectCU GPU cooling technology in the form of the DirectCU III heatsink solution.

DirectCU III is a further evolution of the renowned DirectCU II cooler.

Delivering OdB Fan Technology for silent operation below 65°C, made possible by highly effective 10mm heatpipes, the STRIX R9 390X can deliver silent gaming capability under lower graphical loads such as those found in popular MOBAs such as League of Legends and DOTA 2.



When pushing high graphical loads, such as found in Triple-A game titles, the three 90mm fans keep the card cool and ready to push the next frame out to continue your gaming adventure. ASUS understands the importance of quality component choice, but also strives for the utmost quality from the design perspective. Implementing a metal backplate, this part of the STRIX R9 390X heatsink solution reduces potential for GPU PCB sag – a frustration for any gaming enthusiast. Furthermore, with the addition of the new GPU-Fortifier, there is now even more rigidity within the card's structure, ensuring the heatsink maintains a flush contact with the GPU core, maximising cooling ability.

Introducing Auto-Extreme Technology

AUTO-EXTREME brings premium aerospace-grade quality and reliability to the new STRIX Radeon 300-series graphics card range. At the heart of Auto-Extreme Technology is the ability to surface mount components with an automated manufacturing process.

The benefits of Auto-Extreme Technology are numerous and include even further improved quality control with machine based optical and laser component installation scanning, significantly reducing potential for faults. Additionally, the new process is a flux-free production

method, resulting in no oxidation on the PCB or component connectors. By removing flux from the manufacturing process, this also reduces electricity consumption during production by 50% - half!

For those that enjoy holding their new graphics card before installing into their system, you'll be happy to know that due to the Auto-Extreme Technology, the rear of the graphics card is now smooth and absent of any protruding component connectors. But don't go slapping your friend across the face with it. That'll still hurt.

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